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BONDED REFRACTORIES FOR SPECIAL PURPOSES

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Abstract

Bonded special or super-refractories and glass have much in common since both are essentially silicates which contain alumina and certain fluxes of varying degrees. All refractories are attacked by molten glass in varying degrees. There is no perfect refractory and service behavior is not always predictable due to varying operating conditions. The furnace designer is seeking a balanced unit in which all portions would fail simultaneously.

By composition, bonded refractories may be classified as acid, basic and neutral. By methods of forming they may be classified by 1) hand molding, 2) slip casting, 3) pneumatic tamping, 4) extrusion, 5) machine pressing. Slides showing each of these methods of forming were shown. The characteristics of the products of each type were given, as well as the limitations of the various processes. The effect of glass furnace atmosphere on refractories was covered, bringing in the possible effect of trace elements in fuel oil. The recommended checker is one in which the alumina is not high enough to allow a crusty deposit to form but which is not siliceous enough to flux away rapidly.

Refractories of the alumina-silica group (mullite) were thoroughly reported, with special attention devoted to the sources of raw materials, both domestic and foreign. Mullite refractories are of three types, those made by complete fusion of silica and alumina bearing minerals; those in which mullite is crystallized out of mixtures of minerals by heating below the fusion point; and mullite which is produced by calcining minerals of the sillimanite group. Numerous slides showing the application of mullite refractories fortifying glass furnace melting soda-lime, boro-silicate, plate and window glass were shown. The use of refractory products of zircon and zirconia in conjunction with fluoride opal, boro-silicate and special glasses (but not for soda-lime glass) was discussed.

A number of slides illustrating a few of the more common causes of failure of glass furnace refractories were shown. It was emphasized that special refractories are no substitute for furnace design, proper burner alignment, dusty batch charging, operator incompetence or other poor practices which are unduly hard on furnace refractories.

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Introduction

Bonded special or super-refractories and glass have much in common since both are essentially silicates which contain alumina and certain fluxes in varying degree. Glass products must have eye appeal and most of the defects which are incidental to the melting, refining and forming of the finished ware are readily apparent. Refractories can not be judged by the eye alone and must either be used or tested under conditions which simulate those which will be encountered in service before their quality and suitability can be determined. We shall confine our remarks to a practical discussion of the bonded special refractories which are being widely used by the glass industry and with which we are most familiar, including data which we hope will bring the user and the producer closer together in an understanding of common problems.

There is no special refractory, bonded or otherwise, economically available which molten glass does not attack. The rate of attack is determined by: 1) Composition of the raw batch; 2) Composition of the refractory; 3) The physical structure of the refractory (density and grain size) Crystalline structure (concentration, composition, size and orientation of crystals) are *quite* important, maybe more important than composition; 4)

Location of the refractory in the furnace; 5) Operating temperature; 6) Production rate or 'pull' of the furnace; 7) Velocity of furnace gases; 8) Furnace atmosphere.

In practice, if the several types of refractories required for furnace construction are chosen properly and the furnace is built and operated according to accepted principles, the critical parts of a well "balanced" furnace will wear out approximately simultaneously like the 'one horse shay', yielding lowest potential refractory cost per ton of product. The experience of the designing engineer, the operator and the refractories engineer must be combined if this aim is to be accomplished. There is no perfect, all purpose refractory and even after long experience in the manufacture and application of refractories, the producers can not always predict behaviour in service due to some operating conditions which may vary from time to time, not the least of which is the human element. Some practical service test may be necessary before the most economical combination of special refractories available may be selected.

Part I

Classification of Refractories

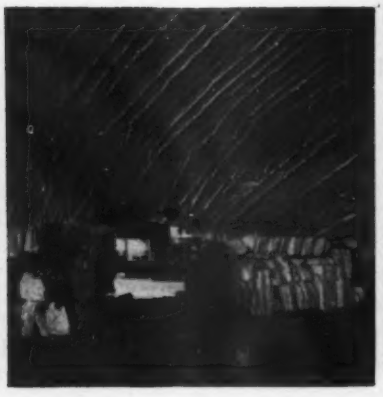
ACID	BASIC	NEUTRAL
Silica	Periclase	Chrome
Fire Clay	Magnesite (Burned and Unburned)	Chrome-Alumina Spinel
Super-Duty Fire Brick	Chrome-Magnesite	Fused or Sintered Alumina
Hi-Alumina made of Diaspore (25-50% SiO_2)	Forsterite	
	Magnesia-Alumina Spinel	
Calcined Kaolin		
Sillimanite or Mullite		
Zircon ($ZrSiO_4$)		

We should point out here that even the most modern, high temperature glass melting furnaces are not run above the safe operating limits for any good quality of either silica or fire clay brick from the standpoint of temperature alone. Fig 1. It is the type and amount of fluxes present which react with the refractories at high temperatures to cause failure. Fig. 2.

Soda, lime, magnesia, borax or boric oxide, arsenic, lead and potash are all active fluxes and, singly or in combination, they react with refractories at relatively low temperatures. D. W. Ross[1] in his study of the corrosion of clay tank blocks has stated that the glass batch dissolves the exposed block surfaces to form a clay bearing glass. This glass, being richer in alumina than the glass batch sinks readily. Dissolving of the contact face proceeds in proportion to the removal of the clay bearing glass. However, if this glass is not removed from any given portion of tank block surface, such glass at and near the surface, becomes saturated with the products of re-action and further solution practically ceases as equilibrium is reached. It follows that any increase in furnace 'pull' usually involves higher furnace temperature, increased batch melted and in contact with the tank blocks and shorter block life. The need for tank blocks having added resistance to solution is apparent.

The alumina bearing glass which forms at the top of the blocks tends to flow downward over the vertical face, providing some protection. If there are horizontal joints between blocks or defects in the surface where glass can get into, downward facing surfaces are present, from which the alumina bearing glass, being higher in specific gravity, settles and flows away, exposing new surface to attack. Such upward eating is characterized by circular holes roughly 3/8" in diameter which are drilled vertically upward and which accelerate rate of solution of the tank block.

Fig. 1. Silica brick melted on Sillimanite brick. No fluxes present. Fig. 2. Affect of fluxes on softening point of refractories. Fig. 3. Comparison between mullite-fortified (S-24) and standard bonded mullite bodies after service in glass tank forehearth. Resistance to attack by glass fluxes may be increased by the addition of crystalline alumina to a bonded mullite body. The alumina also acts as a mineralizer promoting the development of secondary mullite within the bond.



g. 4. (Left) bonded mullite ver block over tank connection. ote absence of dripping after 12 onths. Fig. 5. (Right) Clay flux ality cover block over tank connection in same furnace. Block has been seriously attacked by glass, eroded to the level of the metal line. Note presence of drips and iron stained glass.

Fig. 11. Section through used and new bonded mullite spout or nose liner. Spout at left in continuous service for 15½ months serving a paste mold tumbler shop. Cut-off averaged 65 per minute.

Fig. 6 and 7 show clean appearance of bonded mullite brick and special shapes which form the arch or roof of feeder forehearth after 56½ months of service, three campaigns. 129,283 tons of glass melted.

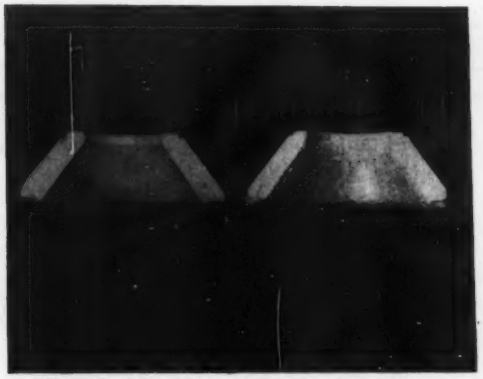
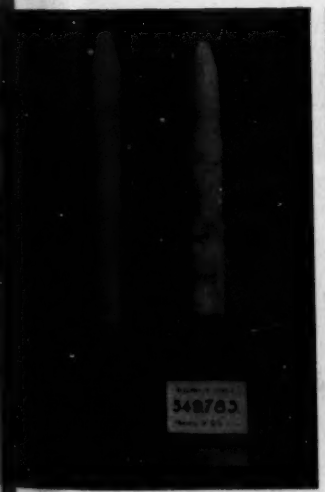
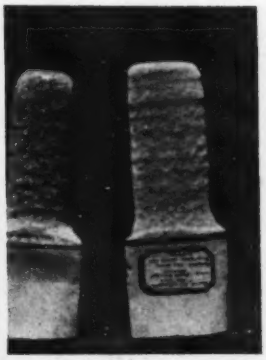


Fig. 12. Comparison between new and used bonded mullite orifice ring after service. Ring at right had been in service for 105 days, passing 4,627.26 tons of flint glass in that period.





ig. 8. (Left) slip cast bonded ullite feeder plungers. Compari- on between new and used part fter 549,785 lbs. of dense, opal lass. Fig. 9 (Center) Comparison etween new and used bonded ullite feeder tubes. Tube at right had been in service to produce 378,400 lbs. of dense, opal glass. Fig. 10. (Right) Section through used and new bonded mullite bell type feeder tube after 8 weeks in flint glass for milk bottles.

Fig. 13 and 14. (Right) Results of corrosion test made to determine the relative resistance of standard and high fired bonded mullite bodies to attack by molten glass. Pieces rotated for 120 hours in opal glass melted from cullet. Both test pieces were cast from the same body. The piece at left was fired to standard temperatures; that at the right was fired

Effect of Furnace Atmosphere on Batch Ingredients

Sodium sulphate and other sodium compounds appear to be more active on tank refractories under strongly reducing conditions. Under reducing conditions the tank blocks, in particular, appear to be destroyed by the actual penetration of sodium compounds into the pores of the refractory. It appears probable that under reducing conditions, the composition of certain soda compounds in the glass is altered, and possibly the interfacial tension between glass and tank block, with the result that these soda compounds more readily "wet" the block and penetrate into it. In the case of "salt water", it is probable that sodium sulfate is dissociated by CO, yielding some sodium sulfide. If the furnace gases contain much free hydrogen, this dissociation might liberate minute quantities of sodium oxide. Salt cake added to the batch, will, on rising to the surface of the melt as salt water, come in contact with the reducing furnace atmosphere and dissolve any siliceous formation present on the surface of the glass and prevent the accumulation of a siliceous scum. In the absence of carbon in the batch, it probably does not require much salt cake to result in an excess that floats on the glass. This is an active agent in the erosion of tank blocks at the metal line and it speeds up the rate of attack on the adjoining tuckstones, plate blocks and ports. It has been observed that furnaces which are fired with fuel oil take a heavier toll on refractories than those which are fired with natural or producer gas. The fluxes present in the oil ash and the possibility of operating with a reducing atmosphere, particularly if the checkers are plugged from batch carry-over, may bear out the theory which Mr. Ross has outlined.

Checkers

Sodium sulphate may be carried over into the checkers and may cause a peculiar type of structural failure where successive layers or "leaves" will break away from the surface of the brick. The reaction is a low temperature one resulting in the formation of relatively low density compounds such as sodalite and noselite. The accompanying volume increase produces a shearing effect. Under these conditions a high alumina checker, or one consisting essentially of mullite, fails more rapidly than a more siliceous one. When the regenerator temperatures are high, glass is formed instead of the crystalline products and the shearing stresses are not present. Several investigators have shown that a similar "shelling" may take place with checkers in furnaces melting salt cake free batch, due to absorption of soda at moderate temperature and the formation of nephelite which again has a relatively high specific volume. While similar effects have been found with ordinary fire clay checkers, the rate of disintegration generally increases with the alumina content. On the other hand, the rate of loss from "slagging" in the high temperature parts of the regenerators decreases as the alumina content increases.[2]

It is seldom that the use of a high priced special refractory checker is justified. The best balance with available refractories is to use one in which the alumina is not high enough to allow a crusty deposit to form and clog the openings but which is not siliceous enough to flux away rapidly. The desired checker composition will, of course, change with the regenerator temperature and the nature of the carry-over.

Forming Methods

Returning to the Classification of Refractories, time and the background of our experience permits us to enlarge upon only the properties and uses of mullite or sillimanite, high alumina and Zircon bonded special refractories for the glass industry. As plant operators we believe that you will benefit by a brief review of the several methods which are generally used to produce standard bricks and special shapes. Each has its limitations and an understanding of the methods used may save you money, delays and disappointments.

Within the limits of a given type or composition of any bonded special refractory, the properties of the finished product may be varied to meet individual service conditions. Modifications may be made in the forming process, grain sizing, chemical composition and the firing temperature which will affect the density, porosity, hot load strength, shrinkage on re-heat and resistance to spalling. In high alumina refractories the type and amount of bond present is very important. If it is high in silica, it will be converted into liquid by the soda present in the glass batch and will flow away, carrying grog particles with it. Briefly, the forming process may be described as follows:

Hand Molding

This, the oldest method of forming bonded ceramic products, requires little explanation. The body requires a relatively high bond clay and water content in order to develop workability. Molds are usually of simple construction and are usually made of wood. The structure is relatively 'open' and hand molded shapes usually have low mechanical strength, high porosity, low density and poor resistance to slag attack. Spalling resistance is comparatively good.

Limitations. The structure of hand molded shapes is not as uniform as those which are machine pressed, pneumatically tamped, extruded or slip cast. Shrinkage on drying and firing is relatively high and close tolerance to dimension and flatness can not be held unless the piece is ground or finished after firing. Most refractories manufacturers make a nominal extra charge for the additional grinding operation.

Slip Casting

In this process the batch ingredients are mixed, frequently under vacuum, to the consistency of a heavy slip or creamy slurry. The addition of 15 to 25% of bond clay, plus an electrolyte and water, are required to develop a flowing consistency. It is then poured into plaster molds, similar to the practice followed in the casting of metals in sand. The slip cast process lends itself to the production of large or small intricate shapes, feeder parts, crucibles, small burner blocks, plates and slabs. Cast pieces are uniform in size and structure and are produced with smooth, clean outer surfaces.

Limitations. One plaster mold usually produces only one piece per shift, depending upon the size of the piece.

Fig. 15. Before service.

Fig. 16. Condition after 12 months.

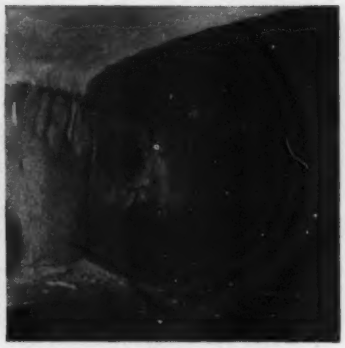


Fig. 17. Bonded mullite burner block projection 3 to 4″ beyond adjoining fire brick in port snout.

Fig. 18. Bonded mullite unit port jamb, breast walls, tuckstones and port sills after 765 days of service. Tank ran 362 days on lead glass and 305 days on flint glass tubing.

Fig. 19. Bonded mullite brick used to prevent dripping of refractories in refiner walls.

Fig. 20. Bonded mullite brick and shapes used for suspended end wall and batch feeder opening.

Fig. 21. Bonded mullite suspended end wall in window glass tank after 832 days.

Fig. 22. Bonded mullite brick and shapes in end wall of plate glass tank after 44 months and 20 days. Bonded mullite above glass line.

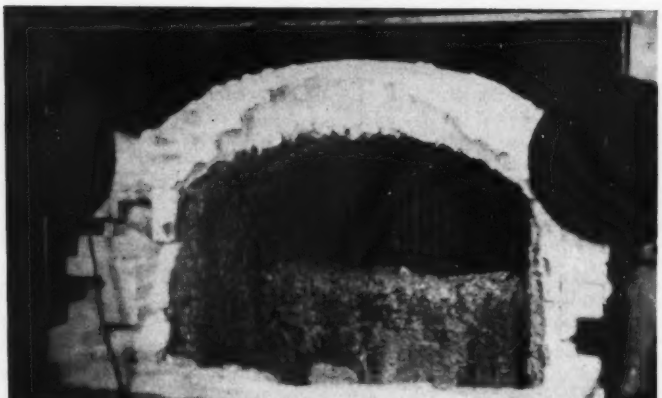


Fig. 23. Condition of bonded mullite brick, laid with thin trowelled joints of mullite air-setting cement, after furnace campaign melting plate glass. Veneer 4½″ thick in port walls with 9″ port crown. This is the *first* port. Note tight joints in the port crown and absence of slagging of port side walls.

Fig. 24. Compare with Fig. 23. *Third* port of same plate glass tank showing condition of the 4½″ veneer of bonded mullite brick in port side walls and the 9″ fire brick port crown, laid in chrome base, high temperature cement.

The water is absorbed into the mold by capillarity and if the mold and cores are withdrawn too soon, slumping or cracking of the piece will result. To increase production, duplicate molds may be cast from the plaster model, but at increased investment in molds. Cast bodies are relatively fine grained in structure and are more subject to cracking from heat shock. Slip cast shapes are NOT recommended for tuckstones, port arches, jambs, port entrance blocks and other similar parts which are used in the super-structure of high temperature glass melting furnaces, due to the higher bond clay content.

Pneumatic Tamping

There are several variations of this process. Batches having a relatively high water and bond clay content may be tamped in molds, representing some improvement over ordinary hand molded shapes. A special forming process used here and abroad involves the mixing of the raw or calcined base ingredient with the minimum amount of bond and water, usually 5 to 6%, tamping the prepared batch in a multitude of densely rammed layers in a very heavy, steel lined mold. Pieces are rammed to finished dimensions, with no allowance for drying and firing shrinkage necessary. Large or small special shapes can be made in quantity which will duplicate the density and properties of machine pressed brick. This process is preferred for the making of bonded mullite, sillimanite, high alumina and Zircon shapes and blocks for the glass industry. As we shall describe later, bond clay is NOT added in the manufacture of Zircon refractories.

Limitations. Pneumatic ramming does not lend itself to the production of small pieces having thin sections, or to the molding of intricate shapes. The molds required are expensive and unless a stock mold can be blocked down an order for a few pieces may NOT warrant the mold investment. Calcined sillimanite and kyanite, sintered mullite, and corundum are essentially non-plastic and with low bond clay and water content, edges and corners on the finished piece are frequently rough and friable and are subject to damage in handling. This could be overcome by an increase in the bond clay and water content, at the expense of desirable service characteristics. In high temperature, super-refractories "beauty is more than skin deep".

Extrusion

Few glass house refractories are produced by this process as the die investment is very high and the process is limited to high quantity production of standard items. Some feeder plungers are extruded, with the working end formed by hand shaping after the column has been extruded, usually de-aired, and cut to length. Clay tank blocks of good quality have been produced by this method. It does not lend itself to the production of low clay, essentially non-plastic bodies. Properties of the finished refractory would be on the order of those which were produced by slip casting.

Limitations. The obvious limitations are the very high set-up and die cost, plus the high clay content required to develop workability.

Machine Pressing

All standard brick sizes and most all special checker bricks are produced by this method. Bonded special refractories are usually made on heavy duty dry presses or hydraulic presses which include some method of extracting air from the mold or die during the pressing operation, to eliminate pressure cracking. Bricks and shapes made in this manner are dense, of uniform structure and of relatively low bond clay and water content. Standard bricks are produced at the rate of 8 to 10,000 per shift as compared to 15 to 20,000 nine inch series per shift for ordinary fire clay brick.

Limitations. The cost of alloy steel dies and interruption to production for frequent die changes make it impractical to press other than standard sizes, unless ordered in quantities which are sufficient for a days run. Die costs of $2,000.00 to $3,000.00 each are common. There are certain practical limitations on the size, thickness and shape of an article which can be pressed.

Part II

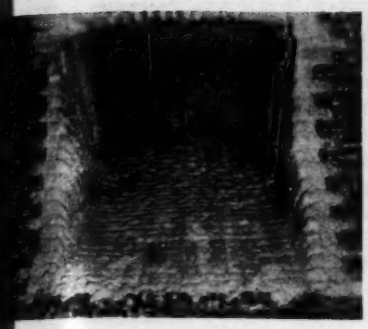
Raw Materials

With a minimum of 50% alumina as an arbitrary basing point, the P.C.E. or softening point of any refractory within the alumina-silica group increases in direct proportion to the alumina content. The resistance to attack by slags and glasses which are high in soda follows in the same order. The raw materials which are commonly used for the manufacture of high alumina, special refractories include diaspore and bauxite, both hydrated aluminum-silicates; the so-called sillimanite family of minerals which includes sillimanite, kyanite and andalusite; and crystalline alumina or corundum. The performance of the special refractory in glass furnace service can NOT be judged solely on the alumina content, however. For example, it is characteristic of high alumina refractories which are made of calcined diaspore or bauxite to continue to shrink in service even though the diaspore or bauxite have been thoroughly calcined at a temperature which is equivalent to that which is encountered in service. Shrinkage at the hot face causes open joints, exposing five sides of the refractory to further attack. Shearing or peeling of 70 and 80% Al_2O_3 brick in glass tank breast walls and port side walls have been observed. The amount of glass present within the refractory and the crystalline or mineral changes which are accomplished by grain preparation and by high firing effect the amount of mullite developed, the strength and resistance to slag attack.

Mullite

Bonded mullite special refractories are used quite generally in glass furnace construction, to re-enforce those parts which are subject to short life or early failure when built of silica or ordinary refractories. It is significant that the development of improved tank blocks for service below the glass line, places a heavier load upon the furnace super-structure, requiring better refractories for the construction of breast walls, ports, burner blocks, front and end walls and even crowns for some special glasses. We expect that as better tank blocks are made in the future, there will be an even greater demand for bonded special refractories for other parts of the 'balanced melting unit'.

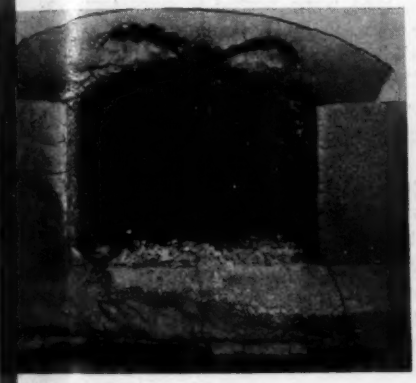
The sillimanite family of minerals includes andalusite,



25. Bonded mullite brick used to sup-
uptake of No. 1 port of window glass
ce. Mullite brick built into fire brick
over regenerator. Photograph taken
regenerator with checkers removed,
g through uptake of No. 1 port,
one campaign. Mullite brick in port
also apparent. Note lack of shrink-
nd joint erosion of mullite brick.

26. Photograph with is similar to
25 taken in the regenerator chamber
checkers removed.

Fig. 27. Bonded mullite mantel arch and mantel block *after* 22 months of service in end fired container tank. Port jambs, arch and entrance blocks are also bonded mullite.



28. Fortified bonded mullite shapes used
construction of back port of oil and/or gas
container tank. Tank operated for 18
hs, firing oil about one-third of that time.

Fig. 29 and 30. Illustrating how bonded mullite brick were used to hot patch silica crown and port arch of continuous container tank. Sillimanite brick installed without pre-heating. Photographs taken after six months.

31. Test flux blocks of bonded
llite after 12 months in borosilicate
ss.

Fig. 32. Bonded mullite shapes used to prevent dripping of nose blocks in suspended shadow wall. Flat glass.

Fig. 33. Bonded mullite blocks used for eye of regenerative pot furnace after 5 years and 3 months of service.

kyanite and several forms of sillimanite—all of them having the same chemical composition—1 Al_2O_3:1 SiO_2 or approximately 63% Al_2O_3 and 37% SiO_2. They vary in specific gravity, that of kyanite being 3.63, sillimanite 3.23 and andalusite 3.20. There are distinguishing differences in the crystal shapes and in the optical characteristics. Deposits of kyanite occur in many places in the U. S. and throughout the world, but in nearly all cases, concentration is required in order to obtain a marketable material. In the U. S., the mineral is usually associated with mica and quartz, as in North Carolina, or with quartz alone as found in the Western States, and in Australia. It is characteristic of domestic kyanite and of the relatively pure kyanite which is now being mined in British Africa to become weak and friable upon being calcined. This limits their use to some extent in the manufacture of top quality bonded mullite special refractories. The grains tend to shatter and break down in screening, blending and mixing, producing finished refractories of low density, high apparent porosity and relatively low hot strength.[3]

The only known commercial deposit of andalusite in the U. S. occurs in the Inyo Range in California. For many years this deposit was worked extensively to obtain material for spark plug porcelains, chemical porcelain and refractories. The andalusite was hand picked to obtain material of suitable grade and the workings have now been abandoned due to impracticability of obtaining sufficient quantity of suitable ore at reasonable cost.[3]

Mullite as a natural mineral is rare and there are no known commercial deposits of it. It is surprising, therefore, that this mineral, whose composition is 3 Al_2O_3:2 SiO_2 (or approximately 72% Al_2O_3 and 28% SiO_2) is the most stable aluminum-silicate that is known and that it should be formed when the minerals of the sillimanite group are decomposed by heat or when a mixture of alumina and silica is heated at a high temperature. The inversion of the natural minerals of the sillimanite group to the more stable form of mullite is accomplished by calcination. Kyanite inverts to mullite at a temperature of about 2400°F, andalusite at about 2450°F and sillimanite at about 2550°F. After calcination, sillimanite and andalusite remain hard and tough and are well suited to the manufacture of bonded mullite refractories. In the case of kyanite, however, only the Indian material retains a high degree of strength after calcining. This seems to be due to a peculiar orientation of the mullite crystals, as well as to the presence of excess alumina in the form of corundum.[3]

India has, and probably will continue to be, the world's largest source of the purest and most desirable deposits of top quality kyanite and sillimanite for refractory purposes. Methods used for mining, selection and transporting of the ore are crude by modern standards and conditions within India have been most unsettled since World War II.

Indian kyanite has been in short supply and although conditions have improved, we anticipate that Indian kyanite of high quality will continue to be scarce and only at increased cost. Further, minerals which occur in nature are subject to variation in composition and purity and Indian kyanite is no exception. Calcined Indian kyanite, or substitutes for it, may be up-graded by blending with crystalline alumina in some form, which increases the alumina content and which serves as a mineralizer to promote the development of secondary mullite within the body. Fig 3. Bonded mullite refractories of uniformly high quality are produced by blending synthetic mullite with calcined Indian kyanite.

Artificial or synthetic mullite may be made in several ways. It can be made from mixtures of alumina and silica bearing minerals, such as diaspore or bauxite and clay, or alumina and silica sand, heated to the point of incipient or complete fusion, usually in an arc type electric furnace. Mullite is so prone to crystallize from melts of the proper composition that crystallization cannot be prevented, even by chilling with water. The mullite crystals are usually quite pure, although they sometimes contain iron oxide, apparently in solid solution. This tendency of mullite to crystallize in the pure state can be a decided disadvantage in the manufacture of refractories, due to the fact that the more refractory constituents have crystallized out, leaving an easily fusible glass as an envelope around each crystal. As the commercially available raw materials used for the manufacture of synthetic mullite are by no means chemically pure, the quantity of glass remaining after crystallization may be appreciable. Bonded refractories made of mullite of this type could be expected to have some deformation under load when heated to high temperatures as the glass between mullite crystals will soften, allowing them to slide over one another. Synthetic mullite of higher quality is produced by providing an excess of alumina or some other constitutent which will increase the P.C.E. or viscosity of the glassy portion of the body.

Synthetic mullite is also being made by heating mixtures of alumina and silica bearing minerals to the point where mullite crystals of desired orientation are obtained, but not to complete fusion. When properly made the sintered mullite has a number of desirable characteristics, such as high density, fine interlacing crystal structure, high mullite content and low iron content.

Mullite refractories may then be divided into three classes: 1) Mullite made by complete fusion of silica and alumina bearing minerals. The outstanding products which are produced in this class are those which are electrically fused and sold in the "as cast" condition. 2) Mullite which is crystallized out of mixtures of silica and alumina bearing minerals by heating below the fusion point. 3) Mullite which is produced by calcining minerals of the sillimanite group.

Uses of Bonded Mullite Refractories

Bonded mullite super-refractories are used in the "balanced" tank to strengthen critical parts or areas in which silica, super-duty silica, fire clay, super-duty, kaolin or other special refractories fail or which require hot repairs during the campaign. The accompanying photos illustrate typical uses and results.

These refractories are used extensively for expendable feeder parts and for the construction of complete feeder forehearths. Here, they not only last longer than even the best grades of clay or silica parts, but they materially improve glass quality and increase production. 1) The rate of erosion is less, hence there are fewer shut downs

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A PHOTOELECTRIC METER FOR SHADE NUMBER CLASSIFICATION OF INDUSTRIAL EYE-PROTECTIVE GLASSES

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Abstract

In this paper, constructional details and operational procedures are given for a photoelectric meter, incorporating a modulated light source, for use in the classification of the shade numbers of industrial eye-protective glasses. Use is made of a set of standard glasses with which production material may be rapidly compared and segregated for storage or supply on outstanding purchase orders.

I. Introduction

Rapid production classification of the darker shades of industrial eye-protective glasses has in the past been difficult and often inaccurate. There have been two reasons for this situation. First, until recently[1] the standards of luminous transmittance employed in this field were not too accurately calibrated since they were in most cases based on visual photometric tests wherein the spectral response and state of adaptation of the observers' eyes markedly affected the results[2, 3]. Secondly, electronic equipment for making rapid and accurate photometric comparisons has not been too widely available.

A set of standards for use in rapid shade number classification has recently been set up at the National Bureau of Standards. A similar set has been prepared for one of the manufacturers of industrial eye-protective glasses. These standards were established as described in an earlier issue of THE GLASS INDUSTRY[1] by using a Beckman Quartz Spectrophotometer[4] so that all subjective visual evaluations have been eliminated. These standards consist of sample glasses having transmittances corresponding to those near the division points between the various shade number designations. In this respect they become a set of go-no-go standards which may be used to set the upper and lower limits of any densitometer scale for evaluating the various shade numbers. It is the purpose of this report to describe briefly a simple and accurate meter* for rapid shade number classification of industrial eye-protective glasses, making use of a set of these standard glasses.

II. Description of the Instrument

This instrument consists of, briefly, a modulated light source, a photoelectric detector, a tuned amplifier, a rectifier, and an indicating meter.

The modulated light source consists of a 100-watt incandescent lamp (in clear glass bulb, the CC-6 coiled-coil filament type being preferable), an 1800 RPM synchronous motor together with a sector disk, and a simple condensing lens of about 6 diopters power. The sector disk has 17 equally spaced openings, which may be made by drilling holes at intervals of $360° \div 17$ along a circle marked on a flat circular metal plate. The diameter of the openings should be approximately equal to that of the untouched metal between openings. The disk may be situated at any position in the light beam between the lamp and the phototube (see Fig. 1), but for best results it is preferable to place it at a position such that the useful light beam is only slightly less in area than that of the disk opening.

The use of a modulated light beam makes possible the use of this instrument in a fully lighted room having normal light fluctuations, without noticeable effect upon the meter reading, since only changes within the beam path are registered and then only if at a frequency near that of the modulator. This characteristic is very important in adapting this instrument to operation under factory conditions.

The photoelectric detector in this instrument is an RCA-929 phototube. While the relative spectral response of this tube differs considerably from the I.C.I. relative luminosity curve[1, 5] (average spectral response curve of the light-adapted eye), the resulting error in comparing glasses of similar type and color is of secondary importance. A barrier-layer cell over which is mounted a color-correcting filter could be used where more accurate comparisons of luminous transmittances are required, but added difficulties encountered in amplification probably more than counter-balance errors resulting from lack of proper spectral response of the S-4 type of surface.

The amplifier has certain special characteristics which may be noted. The input stage employs a specially selected tube for low noise to signal ratio, the type 1620. The first stage circuit is designed for high signal gain with little attention given to frequency shaping.

The second stage, employing a 6SJ7 type tube, is isolated somewhat by high coupling resistors so that it may be employed in tuning for high frequency selectivity. This is accomplished through the use of a simple phase-shift[5] feedback network coupling the plate and grid circuits of this stage. The amount and phase relationship of the energy coupled back to the grid of the tube is determined not only by the magnitude of the capacitances and resistances within this network but also by their relationship to all other grid and plate impedances within the circuit. In general, however, the frequency f of maximum positive feedback is proportional to $1/RC$ where the capacitances of the network are roughly denoted by C and the resistances by R. From this it follows that the peak frequency (see curve C in Figure 2) may be shifted to lower (or higher) frequencies by increasing (or decreasing) either R or C. In the present instrument we have chosen to make R variable for accurate adjustment to the modulated light frequency of 510 cycles per second. If standard com-

*Designed and constructed in cooperation with Mr. E. L. Hettinger and his associates of Willson Products, Inc., Reading, Pa. who now employ the instrument in their plant.

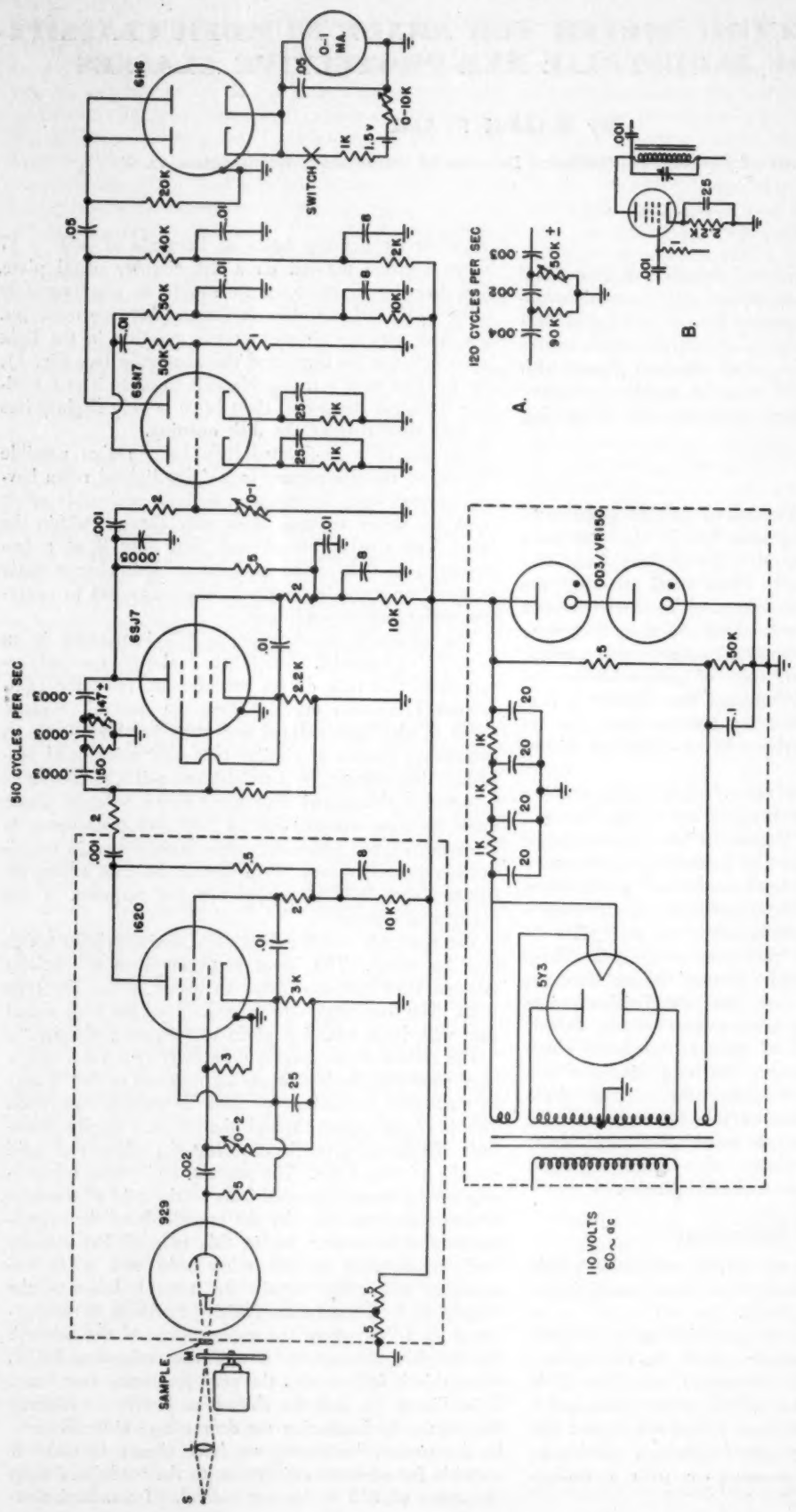


Fig. 1. Schematic wiring diagram of tuned amplifier, showing relationship to modulated light source. Capacitances are given in microfarads and resistances in megohms except as noted otherwise.

mercial mica condensers and ceramic resistors, each of 10 per cent tolerance or better, are employed in the feedback network, oscillation difficulties will probably not be encountered. If off tolerance components are used and oscillation occurs it can usually be easily eliminated through component substitution or by a slight change in the ratio of any pair of the components without changing the peak frequency appreciably.

Experiments were made with other more complicated feedback networks, in particular bridged-T and parallel-T circuits[6], but any improvements over the simple phase-shift network chosen did not seem to warrant the extra circuit complications.

Various filter and tuned impedance circuits were considered, but in general low Q values rule out their use if a narrow pass band is to be retained without excessive gain loss within the amplifier. A tuned (L-C) plated circuit consisting of an audio frequency choke coil (or transformer primary) shunted by a mica condenser is probably the best simple and practical arrangement of this type. Such a circuit has recently been incorporated into a commercial radiation meter[7]. The alternative use of a tuned circuit of this type is shown at B in Figure 1. While this circuit (using a commercial audio choke) does not give a narrow band pass comparable to that obtainable with a phase-shift network, it offers greater stability of voltage gain where large power line voltage fluctuations are encountered. Measured gain changes for experimental set-ups were found to be about one-fourth and one-half per cent respectively per volt change in line voltage for the two arrangements. Band widths of 200 to 300 cycles for one-half peak gain, as compared with 100 cycles for the feedback arrangement, should be obtainable with commercially available audio freqency transformers or chokes shunted with the proper capacity in mica condensers to give the desired frequency of 510 cycles per second.

The remainder of the amplifier circuit is more or less conventional, the primary improvement being the extra precautions taken to isolate unwanted feedback between stages and to reduce 60 and 120 cycle hum to a minimum through the use of a separate chassis for the power supply, shielding, individual plate circuit filters on all stages, and of small coupling condensers at certain positions within the circuit. The overall gain, or sensitivity, of the amplifier is controlled by ganged grid resistors in the first and third stages.

The output from the amplifier, after rectification by a 6H6 twin diode operating as a half-wave rectifier, is registered on a 0 to 1 milliampere short period panel type meter. This meter is shunted by a condenser for purposes of reducing shocks caused by sudden bright illumination of the phototube. Distortion within the amplifier for very high level signals is sufficient to protect the meter against damage for all light intensities which can possibly reach the phototube, although within full scale range of the meter the indication is roughly linear.

III. Operation of the Instrument

For most practical operation of the instrument, it is adjusted for use with one shade number at a time, the sensitivity control and the modulated light intensity being set to give a meter reading near full scale for a

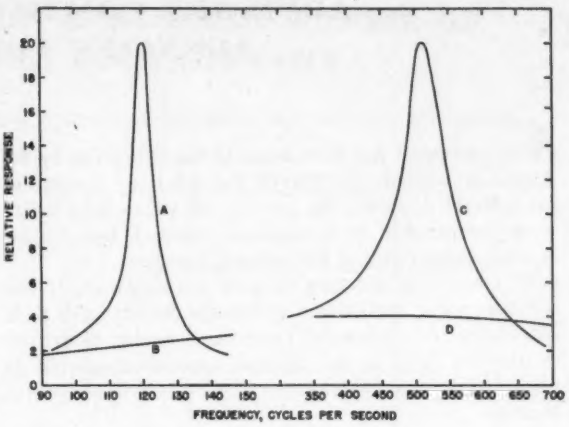


Fig. 2. Relative frequency response of the tuned amplifier as measured across the second and third stages. Curves A and C apply when each of the two tuned feedback circuits are employed, B and D with the feedback networks disconnected.

standard filter corresponding to the "light" limit for the shade number under classification. Next this filter is replaced with the standard representing the "dark" limit for the same shade. Under these conditions the readings may, for example, be .9 and .4 on the meter giving half full meter range corresponding to all possible transmittances passable for that particular shade number. If a larger scale spread is desired, the dark limit may be shifted to, or near, 0 on the meter scale by means of the battery circuit shunting the milliammeter, followed by increasing the modulated light intensity or instrument sensitivity setting to give again near full scale reading for the light limit. The instrument is now ready for use in classifying glass of the particular shade under discussion. All glasses giving readings within the established limits therefore belong to this particular shade number and may be placed into as many groups as desired for puropses of transmission matching, or purchase order or storage requirements. Glasses having off-scale readings belong to lighter or darker shades depending upon the direction off scale. Glasses may thus be rapidly passed through the light beam and their classification as rapidly indicated by the meter reading. If desired in a large scale set-up automatic operation, the entire equipment should be easily attained through the use of suitable relays, belts, etc., so that the only personal attention might be that of stacking samples in place or carrying away the marked and wrapped material.

Set up as shown in Figure 1, the instrument has an overall current amplification of about 25 million when the sensitivity control is set near the maximum value. This sensitivity is sufficient to give at least half full meter scale differentiation between the light and dark limits of shade number 15 industrial welding glass. For the lighter shades, full scale readings may be obtained without difficulty. The intensity of the light source could probably be increased at least two-fold without injury to the 929 phototube either by using a larger lamp or by increasing the optical concentration through the use of a more powerful lens than the one and three-quarter inch, 6 diopter lens employ in the instrument described herein. (*Continued on page* 462)

ADVISORY COMMITTEE FOR FEDERAL AGENCIES FORMED BY A.C.S.

Announcement has been made of the formation by the American Ceramic Society of the Advisory Committee for Federal Agencies, the purpose of which is to foster closer cooperation in fundamental research between the ceramic industries and the national bureaus.

In conceiving the idea of such a Committee, it was felt that many individuals within the Society with their knowledge of industrial problems could contribute worthwhile help to the federal agencies interested in glass and ceramic subjects and thereby receive reciprocal benefits.

Accordingly, the Board of Trustees of the American Ceramic Society has set up the Committee composed of two members of the Glass, Refractories, Enamel, Structural Clay Products and Whitewares Divisions of the Society. Professor John C. Whittemore of Virginia Polytechnic Institute has been named Chairman of the Committee and members representing the Glass Division are Francis C. Flint and Kenneth C. Lyon. Other members of the Committee are James R. Beam, Raymond E. Birch, R. R. Danielson, Frank H. Riddelle, Everette H. Shands, Louis J. Trostel and Hobart M. Kraner. It was agreed by the Committee members that they should start their work with the Bureau of Standards and that all other federal agencies would be approached to determine their wishes regarding possible cooperation in the Committee's activities.

In launching the new Committee for Federal Agencies, Dr. Herbert Insley, Chief of the Mineral Products Division, Clarence H. Hahner, Chief of the Glass Section, and chiefs of several other interested sections of the Bureau of Standards were contacted by the Committee. Subsequently, a meeting was held in Washington at which time Committee members had an opportunity to visit all the laboratories working on ceramic research and obtain a realization of the possibilities for the work of the Committee.

Following this first meeting in Washington, it was decided that each member of the Committee should write out recommended research for the consideration of the Bureau of Standards on each particular industry. As these recommendations have been received, they have been transmitted to the various sections of the Bureau.

Another meeting of the entire Committee is planned for the Fall at which time all recommendations will be reviewed by the Bureau and the Committee as a whole. It is also hoped that members of the Committee from each Division will hold independent meetings at the Bureau and invite several other members of the Society to meet with the particular section chief of the Bureau in charge of the particular material in which the members are primarily interested. In this way, it is felt that the Bureau will obtain viewpoints of a varied group of manufacturers and individuals.

As a result of suggestions by the members of the Committee from the Glass Division, the following recommendations have been made for consideration by Mr. Hahner, Chief of the Bureau's Glass Section: 1) study of the viscosity of simple silicates; 2) investigation of some results indicating that the persistence of cords in glass depends upon the relations between their surface tension and the surface tension of the parent glass; 3) the density of glasses at elevated temperatures.

In connection with the study of the viscosity of simple silicates, it is felt that there is a need for more information on the viscosity of the alkali silicates and alkali lime silicates. It is stated that the Committee, in recommending this study, feels that the work which has been published on the subject is either limited in scope or is not reliable.

The Committee, in recommending pursual of cord research, feels that relative density should also be taken into account. It has been suggested that these studies can be carried out with liquids at room temperatures in the hope of obtaining information before undertaking work on glasses. Since the problem of cords is of paramount importance in optical glass production, it is believed that any information obtained from these studies will be of direct value to the Bureau's own problems.

Concerning the recommended research on the density of glasses at elevated temperatures, the Committee feels that while the effect of composition upon density of glass at room temperatures has been studied with fair thoroughness, there is relatively little information on the effect of composition upon density at elevated temperatures. When such information has been needed, general practice has been to assume that density relationships observed at room temperature would also apply at high temperatures. However, this has not been definitely established as fact. The apparatus available at the Bureau of Standards for determining the viscosity of glass is also suited for the measurement of density. Hence the study of densities and viscosities on the simple silicates can be carried out at the same time.

There is a genuine attitude of cooperation among the members of the Advisory Committee and the National Bureau of Standards and it is hoped that as the Committee work develops that helpful suggestions on fundamental research will be forthcoming from the glass industry as a whole.

WEST COAST FLAT GLASS JOBBERS ASSOCIATION DIVISION

At a meeting called by Harry I. Thompson, President of the Thompson Glass and Paint Company and Vice President of the Flat Glass Jobbers Association, the constitution and by-laws of the Flat Glass Jobbers Association was unanimously adopted and the following officers elected: *Executive Committee:* Harry I. Thompson, Chairman, Harmon Kibbe, Hyman Tyre and Joseph Baiocchi; *Membership Committee:* Harry I. Thompson, Chairman, Nat Shenberg and Lloyd Cobbledick, Jr.

Appointed to the *Budget and Finance Committee* were Joseph H. Grossman, Chairman, Irving Mitchell and Hyman Tyre.

A RECENT TRANSLATION OF A RUSSIAN PAPER OF INTEREST TO THE GLASS INDUSTRY

Abstract of a paper which appeared in the Russian journal of the glass and ceramic industries.

Hardening of sheet glass of different dimensions and its testing

G. M. Bartenev, *Steklo i Keramika* (Glass and Ceramics) 1948, No. 11, p. 18, studied the relation between the size of a glass sheet and its degree of hardening at a given treatment.

The degree of hardening was defined as the path difference Δ between the ordinary and the extraordinary beam of polarized light traversing the sheet, referred to as 1 cm. of the thickness of the sheet. It was expressed in $m\mu$/cm., $m\mu$ being 0.0000001 cm.

The hardening was carried out under plant conditions, the highest temperature of heating being 625°C and the cooling air having the temperature of 25°C.

It is clear that hardening, which is based on the difference between interior and surface layers, makes it easier to achieve the greater specimen, i.e. the greater the ratio of the interior volume to the volume of the surface layers. Fig 1 shows an experimental proof of this. The abscissa of the figure represents the ratio L/d, L being the edge of quadratic sheet and d its thickness. The ordinate is the ratio of the path difference observed to the path difference for large sheets for which Δ is independent of L. Black circles refer to sheets 0.617 cm. and white circles to sheets 2.62 cm. thick.

Fig. 1 shows that one curve can represent the data for both thick and thin sheets. The limiting path difference was 255 $m\mu$/cm. for 0.617 cm. specimens and 800 $m\mu$/cm. for 2.62 cm. specimens. It is seen also that the path difference is independent of the size of the sheet when L/d is 4 or greater, i.e. when the sheet is at least 4 times as broad and long as thick.

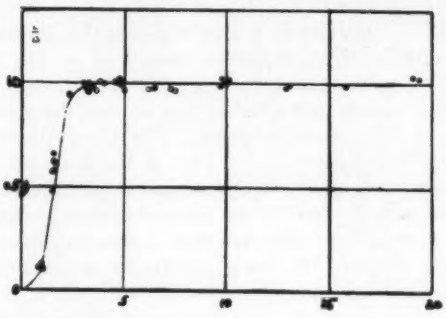


Fig. 1.

This observation facilitates testing of the degree of hardening. If the sheets produced on commercial scale are very large or curved, their optical (photoelastic) testing is troublesome or even impossible. However, if specimens of convenient shape and size are hardened together with the production ware and their path difference is measured, the degree of hardening of the production ware may be assumed equal to that of the small specimens, as long as L/d of these specimens remains above 4. To prevent loss of heat through the narrow edges of the specimens, they may be hardened in a frame made of glass or asbestos.

GLASS WEEK AT OVERMYER MOULD

The recent "Glass Week" held at Overmyer Mould Company and generally supported by the city of Winchester, Indiana, as a whole, included social events as well as the more serious "iron clinic" and excursions through the foundry and glass mold production departments.

The "iron clinic" lecture room was equipped with the necessary materials for demonstrating the various processes in the production of high grade iron. Numerous illustrations of experimental processes, together with slides and iron samples, showed years of work and the thousands of dollars spent in perfecting this glassmould iron.

The "iron clinic" was a review of all the accomplishments made in this field so far and discussions on the development of the metallurgical practices and foundry methods used by the Overmyer foundry were led by H. H. Kessler and C. J. Green of Sorbo-Mat Process Engineers, and Newton Davis, Metallurgist at the Overmyer foundry. It was stressed that the principal requirements needed for a high quality cast iron for glassmoulds are as follows: machinability, density in polish, high thermal conductivity, low thermal expansion, resistance to surface deterioration, resistance to wear, physical properties facilitating repairs.

In the foundry the visitors spent time observing the many technical applications and foundry practices used in order to produce a high quality and uniform product. Photomicrographs were displayed and used to explain the metallographic structures needed to produce the right kind of iron for glassmoulds. The effect of supercooling was explained and metallurgical principles were shown in the discussion. After each lecture roundtable discussions were held.

It was explained that the last four years of research have been directed toward perfecting iron for the container manufacturer. But it was further explained that major research at this time is being directed toward a better iron for plunger and press mould equipment. The research in this field to date was openly discussed and tentative plans for future development were formulated.

• The du Pont Company was owned by 99,663 different stockholders as of June 30, 1949, an increase of 2,224 over the number reported at the end of the year's first quarter, and an increase of 5,419 over June 30, 1948.

INVENTIONS AND INVENTORS

A Summary of Recently Issued Patents of Interest to the Glass Industry

Feeding and Forming

Hartford Feeder for Optical Glass. Fig. 1. Patent No. 2,470,558. William T. Honiss assigned this invention to Hartford-Empire Company. According to the patent, this is the first gob feeder capable of delivering glass free from cords and other defects so that the glass may be used for optical purposes. The general idea is to provide two orifices in a feeder of the usual type, one of which takes all the cordy and otherwise defective glass and discards it while all the glass of optical quality goes through the other orifice and then to lens presses or other forming devices. Of course this feeder is not limited to use with optical glass.

As shown in the figure, a forehearth 10 leads from the melting tank to a well 14 having a glass feed orifice 15 and an auxiliary orifice 16. Above the orifice 16 there is a tube 17 and a plunger 32 which may be constructed and operated as shown in Patent No. 1,760,254 to Peiler. In operation, cords from the upper surface of the glass body 12 work down the tube 17 and onto the plunger 32 as shown by the dotted lines and then out through the auxiliary orifice 16. The glass passing through the orifice 15 is suitable for optical work or other uses. Two modifications are shown in the patent.

The following references are of record in the file of this patent: United States Patents: 1,612,756, Tokunaga, Dec. 28, 1926; 1,737,220, Cramer, Nov. 26, 1929; 1,737,525, Soubier, Nov. 26, 1929; 1,750,967, Rule, Mar. 18, 1930; 1,926,764, Dorman, Sept. 12, 1933; 2,050,205, Bailey, Aug. 4, 1936; 2,050,211, Honiss, Aug. 4, 1936; 2,310,290, Honiss, Feb. 9, 1943, and 2,340,729, Barker Jr., Feb. 1, 1944.

Hartford Feeder Shears. Fig. 2. Patent No. 2,472,560. Charles R. Avery assigned this invention to Hartford-Empire Company. A well known prior form of sheer mechanism is shown in Patent No. 1,760,435 to Peiler and Avery's invention provides an improved control over the movements of the sheer arms as in the Peiler patent.

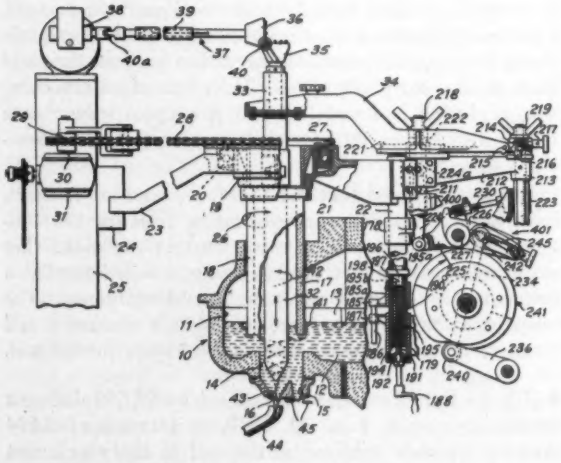


Fig. 1. Hartford Feeder for Optical Glass.

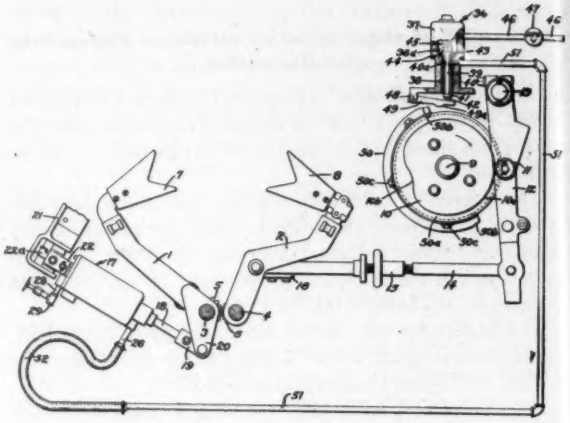


Fig. 2. Hartford Feeder Shears.

In the figure, the shear arms 1 and 2 are arranged to swing about pivots 3 and 4 and are connected by gear segments 5 and 6. These arms are actuated by a cam 10, a roller 11 on a lever 12 and an adjustable link 14. This is all in accordance with the prior art. However, it has been the custom to provide a spring to hold the roller against the cam but this invention provides a cylinder 17 in place of the spring. This cylinder has a piston 23 which is actuated by fluid pressure which might well be air. The piston rod 18 is connected to an ear 20 mounted on the shear arm 1.

The air pressure to the cylinder is controlled by a valve 36 actuated by a cam 50 which causes the air to be admitted at the proper time to cause the shears to close in the same manner as was formerly done by a spring. On the rise of the cam 10 the air pressure is cut off so that the cam does not have to act against a spring as was formerly the case. This reduces wear on the parts and with the various adjustments provided gives considerable advantage over the mechanism previously employed.

The following references are of record in the file of this patent: United States Patents: 1,760,435, Peiler, May 27, 1930; 1,885,302, Slick, Nov. 1, 1932; and 1,976,239, Lorenz et al., Oct. 9, 1934.

Stopper Forming Machine. Fig. 3. Patent No. 2,474,708. Daniel B. Westin assigned this invention to Hartford-Empire Company. The invention is shown as incorporated in the Hartford I S machine, an early form of which is shown in Patent No. 1,911,119.

The machine comprises a bed 1 carrying a standard 2 which supports a two-part mold 3. The transfer mechanism 6 carries the neck ring 4 which is shown in alignment with a pressing plunger 5. This plunger can be elevated so as to press a charge of glass into the cavities 7 of the mold 3 to form five stoppers 9. The stoppers are connected with the residue of the parent body by a small neck 8 which can be easily broken to separate the stoppers. This method of making stoppers and the machine so far as described are well known in the glass business.

The charge of molten glass is delivered to the neck ring while the mold 9 is in open position. The mold then closes and the plunger 5 performs the pressing operation. The mold then opens and the invert by the neck ring 4 takes place as indicated by the dotted lines. This places the stoppers with the attached waste glass on a plate 12 with the stoppers hanging down through an opening, ready to be broken off. This is done by a sharp blow from a stripper bar and the stoppers fall into a chute 21. A gripper mechanism 20 corresponds to the take-out in the ordinary I S Machine. This gripper mechanism actuates the stripper bar and also picks up the remaining piece of glass 10 and drops it into a chute 23 from which it would ordinarily go to cullet.

The claims of this patent are directed primarily to the mechanism for breaking the finished stoppers off from the remaining glass.

The following reference is of record in the file of this patent: United States Patents: 1,776,556, Gray et al., Sept. 23, 1930.

Glass Compositions

Black Glass. Patent No. 2,473,958. Norbert J. Kreidl, Rochester, N. Y., assigned this invention to Monsanto Chemical Company. The glass contains iron phosphide as a colorant and the product is jet black, glossy and opaque.

At the present time, the usual colorants for black glass are mainly the metals cobalt, chromium and manganese which have to be used in relatively large amounts and they are expensive. By the use of ferrophosphorus, only 0.1% to 0.05% is generally necessary although sometimes as much as 1% by weight may be needed.

The patent mentions an earlier patent to Berger, No. 1,961,603, which discloses a glass which is transparent and does not contain colloidally dispersed iron phosphide where as the present glass contains crystals of iron phosphide. This results in a glass which is black and opaque when only two millimeters thick.

In making this new glass, almost any glass making material may be used but the batch should be kept free from oxidizing materials such as sodium sulfate and nitrates such as sodium nitrate. Ferrophosphorus is added in the amount needed to produce the desired black color which, as before stated, will be perhaps as low as 0.1% by weight. Commercial ferrophosphorus comes in pig or lump form but this should be finely powdered before being added to the batch.

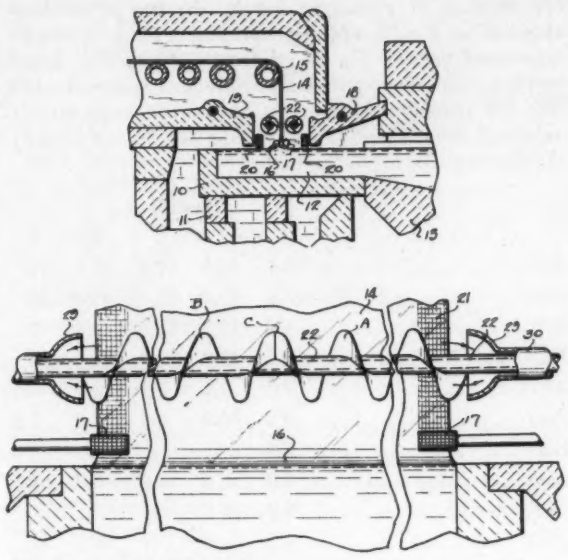


Fig. 4. Drawing Sheet Glass.

The following references are of record in the file of this patent: United States Patents: 1,961,603, Berger, June 5, 1934; 2,224,791, Loffler, Dec. 10, 1940; and 2,314,804, Willson, Mar. 23, 1943. Other References: Journal American Ceramic Society, vol. 24, No. 10 (1941), page 339.

Vitreous Enamel Opacifier. Patent No. 2,474,636. Henry Oesterle and Robert A. Oesterle of Belleville, Ill., invented this composition which relates particularly to

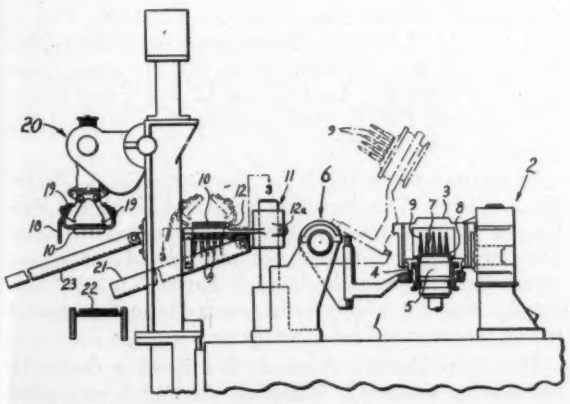


Fig. 3. Stopper Forming Machine.

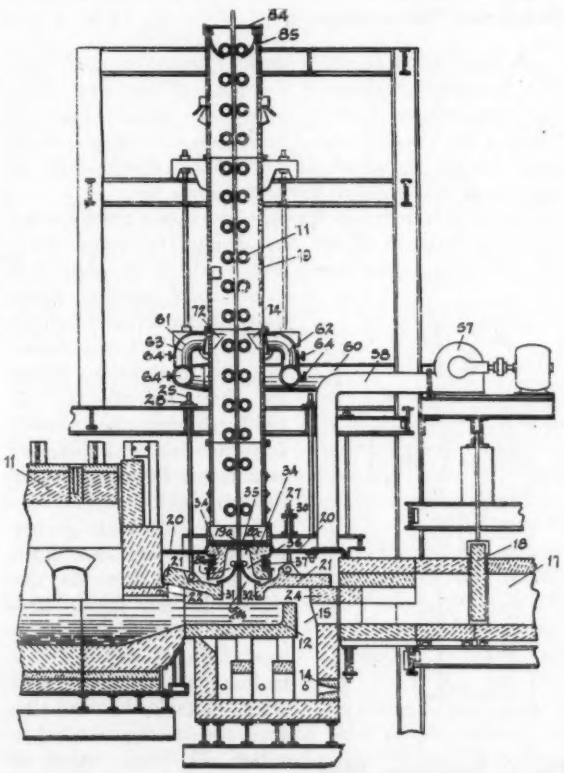


Fig. 5. Sheet Glass Forming Machine.

opacification of zirconium frit by the use of calcined alumina as a mill addition opacifier. These inventors discovered that by the use of from ½% to 8%, based on the weight of the frit of alpha alumina as a mill addition for enamels of this type, the whiteness is greatly improved. Some sample compositions (theoretical melted) are shown in the following table:

	Sample No.				
	1	2	3	4	5
ZrO_2	14.7	14.8	12.8	13.0	11
SiO_2	25.3	27.0	31.6	30.0	48
B_2O_3	9.0	13.7	12.6	13.0	7
Na_2O plus K_2O	12.9	13.0	14.9	14.5	17
Al_2O_3	7.0	7.4	7.7	10.0	...
ZnO	8.4	19.9	2.7	3.0	1.5
BaO	5.4	...	...	...	...
CaO	1.8	...	6.1	6.0	1.5
CaF_2	7.2	6.2	...	...	...
PbO	8.2	...	...	...	...
Na_3AlF_6	...	4.0	...	...	...
P_2O_5	...	...	2.4	0.5	...
F_2	...	...	12.0	10.0	9

The patent gives recommended temperatures and other useful information for using this composition.

The following references are of record in the file of this patent: United States Patents: 1,104,266, Mayer et al., July 21, 1914 and 2,347,187, Frost, Apr. 25, 1944. Foreign Patents: 70,217, Austria, 1915; 5,790, Holland, 1921; and 705,665, Germany, 1941.

Sheet and Plate Glass

Drawing Sheet Glass. Fig. 4. Patent No. 2,470,526. This invention by Donald E. Sharp of Maumee, Ohio, was assigned to Libbey-Owens-Ford Glass Company. "Sheet glass" is understood in the trade to mean window glass, the surface of which is fire finished instead of being ground and polished like plate glass.

It is well known that temperature exerts great control over the thickness of the glass being drawn and variations of temperature across the width of the sheet will cause corresponding variations in the thickness of the sheet. This invention equalizes the temperature across the sheet by drawing air (with perhaps other gasses) from the center of the sheet as it leaves the pool, toward the two edges.

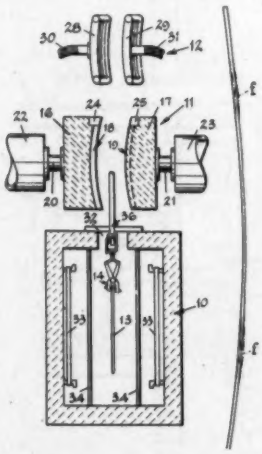


Fig. 6. Supporting Glass Sheets for Bending.

The invention can be employed with any sheet drawing machine but the one shown in the figure happens to be of the Colburn type. A draw pot 10 contains molten glass 12 which comes from a tank 13 and the sheet 14 passes around a roller 15 from which it passes to the lehr and is then cut. The usual cooling devices of the Colburn machine are located near the draw point.

There is a tendency which enclosures do not overcome for the hotter part of the sheet to be in the middle. So this inventor provides air cooled shafts 22 on each side of the sheet 14 as it leaves the draw pot. On these shafts are mounted spiral blades A and B. These are right and left hand meeting in the middle at C. When these are rotated at a proper speed, the hotter air from the middle of the sheet is drawn in both directions so that the transverse temperature is equalized. The passage of the hot air across the sheet is assisted by exhaust bells 29.

This arrangement provides a much greater uniformity in temperature across the sheet of glass and accordingly, greater uniformity in thickness. Several modifications are described.

The following references are of record in the file of this patent: United States Patents: 1,320,091, Proeger, Oct. 28, 1919; 2,158,669, Amsler, May 16, 1939; 2,287,136, Rolland et al., June 23, 1942; and 2,352,539, Halbach et al., June 27, 1944.

Sheet Glass Forming Machine. Fig. 5. Patent No. 2,475,773. George W. Batchell assigned this invention to Toledo Engineering Company, Inc. The invention relates particularly to the control of the temperature in the lehr in which the sheet is annealed as soon as it leaves the forebay. This patent is a continuation in part of an application resulting in Patent No. 2,297,737.

Fig. 5 shows a furnace 11 connected to a forebay 12 heated by burners 14. Part of the products of combustion are taken off through a flue 17 controlled by a gate 18 and another part is delivered to the lehr 19. The pool of molten glass in the forebay is shielded by adjustable blocks 21, the angle of which can be changed by turning nuts on the rods 25 and 27. Mechanism is provided so that adjustment of the blocks 21 also adjusts certain reflector plates which regulate the heat of the sheet being drawn.

The lehr 19 has a series of rollers 71 which draw the glass sheet upwardly. By means of the various adjustments provided, the temperature of the lehr 19 may be regulated as desired. A suction fan 57 aids in controlling the temperatures. The upper end of the lehr is provided with a pair of gates 84 and a pair of elastic wipers 85 both of which help to control the air pressures in the lehr.

The following references are of record in the file of this patent: United States Patents: 1,032,239, Player, July 9, 1912; 1,595,912, Monro, Aug. 10, 1926; 2,002,544, Monro, May 28, 1935; 2,006,167, Hohmann, June 25, 1935; 2,120,452, Amsler, June 14, 1933; and 2,297,737, Batchell, Oct. 6, 1942. Foreign Patents: 102,275, Australia, Oct. 15, 1937.

Supporting Glass Sheets for Bending. Fig. 6. Patent No. 2,476,169. This invention by Gerald White and William A. Smith was assigned to Libbey-Owens-Ford Glass Company. One of the former methods of supporting sheets during bending is shown in Patent No. 2,270,470, but this was not wholly satisfactory due to the imprint left by the tongs and for other reasons.

The figure shows a furnace 10, a bending device 11 and cooling means 12. The glass sheet 13 is suspended by a pair of tongs 14 which are arranged to lift the sheet

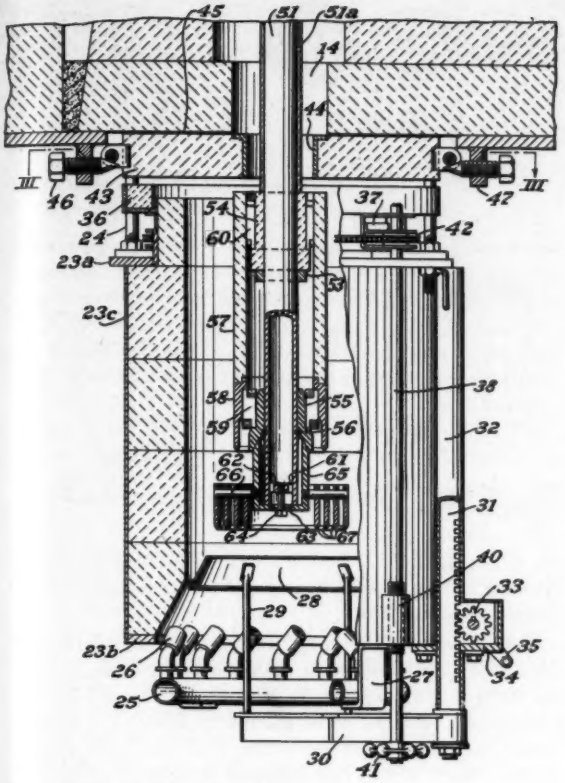


Fig. 7. Danner Tube Machine.

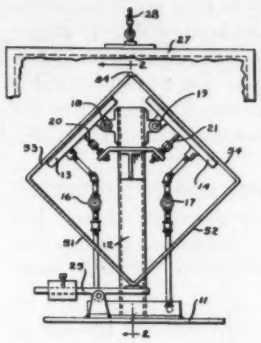


Fig. 8. Method of Welding Glass.

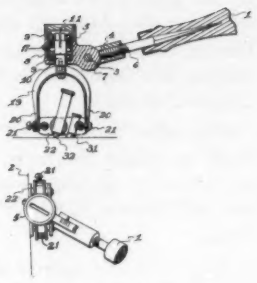


Fig. 9. Glass Cutter.

into position to be pressed to the desired curve, by molds 16 and 17. Notches 24 and 25 are provided in the faces of the molds to receive the tongs 14.

Cooling members 28 and 29 are connected with a source of air pressure so that both sides of the sheet can be rapidly cooled when these parts are lowered into working position. Patent No. 2,369,368 is mentioned as showing the continuous production of tempered glass sheets.

The furnace 10 is heated electrically by elements 33 so as to bring the glass up to about its softening point which may be about 1250° F. A detailed description of the various parts will be found in the patent.

The only reference cited by the Patent Office during the prosecution of this application was No. 2,100,510 to Kotowski.

Tube and Cane Machines

Danner Tube Machine. Fig. 7. Patent No. 2,474,302. This is another of a long series of inventions by Edward Danner of Newark, Ohio. By the use of this machine, it is possible to make tubing having a greater wall thickness than here-to-fore possible and having better quality and at lower cost. The invention is capable of use with Danner's Patent No. 2,390,925 or with the well known Danner Machine as shown in Patent No. 1,219,709.

A forming chamber comprising the parts 23a, 23b, and 23c is suspended so as to receive a stream of molten glass from the port 14. The construction of this chamber may be similar to that shown in Danner's Patent No. 2,462,805. An annular manifold 25 having burners 26 heats the interior of the chamber and so controls the viscosity of the descending glass. A flame deflector 28 is vertically adjustable by means of a crank 35 for regulating the heating. A damper 36 is provided to regulate the draft through the chamber and this may be adjusted by the hand wheel 41.

A blow pipe 51 depends through the port 14 and is connected to a suitable supply of air pressure and means is provided for adjusting the position of the pipe. The pipe is protected in the chamber by a mandrel 57 and ring 58. The various parts are adjustable so as to regulate the flow of an annular stream of glass downwardly between the ring 58 and the bushing 55. A cup shaped member 65 is secured to the lower end of the pipe 51 and it is provided with holes 63 for the escape of air. A series of shells 67 shape the descending stream as shown in the patent before mentioned.

The descending glass passes down on the inside and outside of the mandrel 57 and then is enlarged by engagement with the shells 67. By this construction, tubes having any desired diameter and wall thickness may be produced. The patent shows modifications of the invention.

The following references are of record in the file of this patent: United States Patents: 672, 281, Morrison, Apr. 16, 1901; 1,218,598, Danner, Mar. 6, 1917; 1,219,709, Danner, Mar. 20, 1917; 1,532,514, Raynes, Apr. 7, 1925; 1,574,482, Hirsch, Feb. 23, 1926; 1,766,638, Howard, June 24, 1930; 2,310,474, Teichmann, Feb. 9, 1943; and 2,390,925, Danner, Dec. 11, 1945. Foreign Patents: 38,432, France, Mar. 3, 1931 (Addition to No. 693,153); 506,384, Germany, Sept. 3, 1930; 543,172, Great Britain, Feb. 12, 1942; and 750,425, France, May 29, 1933.

Miscellaneous Processes

Method of Welding Glass. Fig. 8. Patent No. 2,470,376. Morton R. Shaw Jr., assigned this invention to Corning Glass Works. The invention is illustrated by the manufacture of glass tanks from sheets although other uses are obvious.

The apparatus comprises a base 11 carrying an upright 12 on which is mounted two vacuum chucks 13 and 14 which are angularly adjustable. A counterbalance 25 is provided to help support the work and, of course, the usual controls for the vacuum chucks are arranged for handy operation.

In carrying out this method, two sheets 51 and 53 are supported by the chucks 13 and 14 in proper relation to the sheets 53 and 54. The preheating furnace 27 is then lowered to warm up the glass. When the proper tem-

perature has been reached, the furnace is raised and a piece of cane 84 having a conductive coating is placed in the joint to be welded. Electrodes supply current to the coating and then to the cane so that a perfect weld is formed between the adjacent sheets. The cane used for making this weld may be that shown in Patent No. 2,389,-360 to Guyer et al.

The other joints to be made to produce the tank are made in about the same way as described above. The patent shows modifications of the apparatus and this patent and the one to Guyer should be read by those interested.

The following references are of record in the file of this patent: United States Patents: 499,082, Armstrong, June 6, 1893; 1,194,124, Barrow, Aug. 8, 1916; 2,119,-680, Long, June 7, 1938; 2,193,393, Danner, Mar. 12, 1940; 2,306,054, Guyer, Dec. 22, 1942; and 2,389,360, Guyer et al., Nov. 20, 1945. Foreign Patents: 15,303, Great Britain, 1884; 25,756, Great Britain, Dec. 17, 1901; and 391,245, Germany, Mar. 1, 1924.

Glass Cutter. Fig. 9. Patent No. 2,470,444. George A. Philippe of Fort Smith, Ark., invented this diamond cutter for use with a straight edge. The device is particularly adapted for use in cutting large sheets of glass where the operator has difficulty in reaching the distant parts so that the handle 1 must be quite long while the cutting carriage must at all times remain against the straight edge 2. The handle is hinged at 3 to the head 5 in such a way that the handle is maintained at a fixed upward angle. A coil spring 13, the tension of which is adjustable by means of the screw 17, normally holds the head 5 in line with the handle but allows it to turn by contact with the straight edge. A turpentine cylinder 25 applies the liquid to the glass in advance of the diamond 32 which is held in a ferrule 28. Various adjustments are provided so that at all times the head 5 will be held against the straight edge regardless of the angle of pull of the handle.

The following references are of record in the file of this patent: United States Patents: 1,171,738, Mallet, Feb. 15, 1916 and 2,314,327, Drake, Mar. 23, 1943.

Hollow Saphire Articles. Fig. 10. Patent No. 2,471,437. Elgin National Watch Company acquired this invention from Raymond H. Lester, Pittsburgh, Pa., and Melvin C. Cannon, Aurora, Ill. The invention relates to the making of annular articles of high-melting refractory such as aluminum oxide, spinel and the like in which there is a definite direction of the crystal axes. Reference is made to a co-pending application of Lester, Cannon and Alexander by which rods may be made having the same characteristics.

The figure shows a machine for making such articles, in which a burner 45 and powdered refractory from the basket 47 drops into the flame where it is fused. A starting ring R is secured to a rotating plate 32 driven by a motor 40 and the flame is directed onto the top edge of the tubular article which will be built up in accordance with the speed of rotation and rate of lowering the article by the motor 29. The central opening in the article is kept open gas under pressure supplied through a pipe 35.

The following references are of record in the file of this patent: United States Patents: 1,597,293, Ruff, Aug.

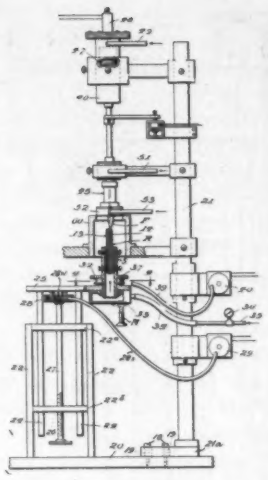


Fig. 10. Hollow Saphire Article.

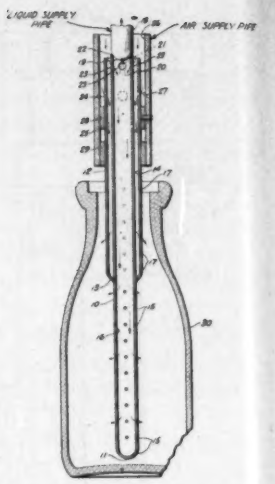


Fig. 11. Tempering Nozzle.

24, 1926; 1,605,073, Ruff, Nov. 2, 1926; and 2,272,342, Hyde, Feb. 10, 1942. Foreign Patents: 241,544, Great Britain, Apr. 1, 1926.

Tempering Nozzle. Fig. 11. Patent No. 2,470,228. This invention by William E. Aksomitas was assigned to Hartford-Empire Company. The nozzle is used in tempering such ware as milk bottles by blowing a cooling fluid onto the inside of the bottle. The particular feature of this nozzle is that two different coolants may be used on different parts of the bottle, such as a water spray on one part and air on another.

In Fig. 11 the nozzle is shown as consisting of a tube 10 having a closed end 11. This tube is enclosed for part of its length by another tube 12 and the projecting part of the tube 10 is provided with holes 15 through which atomized water is discharged. The water comes from the "liquid supply pipe" as marked in the drawing and the end of this pipe 18 is convexo-concave in shape. The "air supply pipe" provides air which is delivered to the upper part of the bottle without any additional water.

The patent states that the various parts may be secured together by brazing or welding or any other suitable known means which no doubt would include solder.

In this way different parts of the bottle may be cooled at different rates in accordance with the particular part of the ware.

The following references are of record in the file of this patent: United States Patents: 846,211, Johnson, Mar. 5, 1907; 1,887,407, Forney, Nov. 8, 1932; 2,066,-283, Wadman, Dec. 29, 1936; 2,180,737, Hess, Nov. 21, 1939; and 2,302,078, Wadman, Nov. 17, 1942.

HARRY COOK RE-ELECTED PRESIDENT OF FLINT GLASS UNION

Harry H. Cook was re-elected President of the American Flint Glassworkers of North America, AFL at the organization's annual convention in Cleveland.

The union represents approximately 35,000 flint glass workers and maintains its national headquarters in Toledo. The meeting was devoted mainly to drawing up proposals to submit to the National Association of Manufacturers of Pressed and Blown Glassware.

GJ Research Digest

The Control of Glass Quality by the Measurement of Refractive Index

In order to achieve a given standard of quality, the glassmaker predetermines the composition from hour to hour, day to day and month to month. However, departures from the theoretical composition occur in practice and give rise to defects, fabricating troubles and the like. In other words, if the composition is kept constant, other physical properties, such as viscosity (which influences workability), density, refractive index and others, will remain constant. Such departures from the theoretical composition may be assigned to a number of causes, for example, variations in composition of the batch mixture, variations in the furnace temperature and variable solution of refractories.

These facts have led to the increasing use of quality control charts in recent years and the routine measurement of some physical property as a check on composition has become necessary. In making the choice of property to be measured, it is evident that it must be sensitive to changes in composition (Editor's Note: It should also be additive in nature); and density, refractive index and softening point have been suggested as suitable for the purpose.

One of the most popular means of control is the measurement of density, either by The Archimedes method or the sink-float method. There are, however, a number of objections to the choice of density and it is the purpose of the recent paper by R. E. Bastick and C. E. Gould (*Journal of the Society of Glass Technology*, February 1949) to show that the measurement of refractive index is a suitable alternative. The advantages of the use of refractive index have not been sufficiently realized, partly because an accurate and rapid measurement is generally regarded as difficult.

The relative effects on refractive index and density of changes in composition are as follows: in general, for a given change in composition, the corresponding changes in refractive index are greater than changes in density relative to the experimental accuracy with which these two properties can be measured. In order to illustrate this fact, a few numerical examples were quoted.

For the first example, a soda-lime-silica glass of composition corresponding approximately to that of drawn window sheet glass was considered and the effects of 0.5 per cent variation in the lime and soda contents on refractive index and density calculated. For the purposes of calculation, the factors of P. Gilard and L. Dubrul relating density and refractive index to composition were used. The results are summarized in Tables I and II.

Over the range of compositions taken, the changes are linear with composition change. Table III shows the changes in density and refractive index for a ± 0.2 per cent change in the sodium and calcium oxide contents.

Considering the magnitude of the changes in the two physical properties relative to the experimental errors, it may be said that the error of measurement in refractive index is at the most 0.0001; that is, equivalent to $\pm .003$ per cent CaO, and it is felt from the data quoted in the literature that the error in the density measurement would be relatively greater than this.

TABLE I

The Effect of Change in Calcium Oxide Content

SiO_2	72.90	72.5	72.10
CaO	8.10	8.60	9.10
MgO	3.22	3.20	3.18
Na_2O	14.57	14.50	14.43
Al_2O_3	1.21	1.20	1.19
Density (calc.)	2.4918	2.4985	2.5051
N_D (calc.)	1.5162	1.5177	1.5192

TABLE II

The Effect of Change in Sodium Oxide Content

SiO_2	72.92	72.50	72.08
CaO	8.65	8.60	8.55
MgO	3.22	3.20	3.18
Na_2O	14.00	14.50	15.00
Al_2O_3	1.21	1.20	1.19
Density (calc.)	2.4948	2.4985	2.5023
N_D (calc.)	1.5168	1.5177	1.5186

TABLE III

Effects of 0.2% Change in CaO and Na_2O Content of a Glass

	Change in Density	*Change in N_D*
$\pm .02\%$ CaO	± 0.0027	± 0.00065
$\pm 0.2\% Na_2O$	± 0.0015	± 0.00035

The method used for the refractive index measurement is known as the reflex-prism method and has been described in detail by J. G. Holmes (*J. Sci. Instr.*, 1945, 22, 219). An outline of this method follows: sodium light from a distant source, which can be moved vertically behind a screen provided with a scale and a movable index, is refracted through a fixed reflex prism and the specimen inserted in the right angle of the prism. The specimen (previously annealed or so treated that all specimens undergo the same heat treatment) is provided with a right angle which can be ground in a few minutes on a grinding table. In order to get continuity of optical path through the compound prism, a small amount of liquid of refractive index approximately equal to that of the test specimen is placed on the ground surfaces. The sodium light source is moved until the movable index coincides with the horizontal cross-wire in the telescope and the position of the index can be read off the vertical scale. This scale can be calibrated against stand-

(*Continued on page* 454)

GLASS CONTAINER MANUFACTURERS AND GBBA SIGN NEW WAGE CONTRACT

As a result of joint negotiations at Chicago, Illinois, an agreement was reached on July 16 between the manufacturers representing the glass container industry and the Glass Bottle Blowers' Association of the United States and Canada, Operating Department. Affected by this contractural agreement are the operators, upkeep men, learners and beginners of all members of the Glass Container Manufacturers Institute.

The new one-year contract, which becomes effective September 1, 1949, grants, in addition to present benefits, three paid holidays in which all plants of the glass container industry will cease production; the establishment of a comprehensive Life, Accident and Health Program covering all employees affiliated with the Operating Department of the G.B.B.A., the cost of such a program being paid in part by the employer and in part by the employee; the manufacturers agreed to request the Glass Containers Manufacturers Institute to make a comprehensive study to see whether or not industry-wide pensions were a possibility.

A change in Article III concerning the settlement of disputes was inserted into the new contract providing for submission to a committee any dispute on which a unanimous decision cannot be reached by the President of the Glass Bottle Blowers' Association and the Secretary of the Labor Committee of the Glass Container Manufacturers Institute. This Committee will be comprised of three officers of the Union and three manufacturers to be appointed respectively by the Union's President, Lee W. Minton, and the Institute's Labor Secretary, Ralph A. Lind.

Representing various manufacturers at the Wage Conference were: Garrett Bryce, Anchor Hocking Glass Corporation; E. J. Kessler, Armstrong Cork Company; A. M. Bracken, Ball Brothers Company; F. B. Hess, Brockway Glass Company, Inc.; Carl Hilgenberg, Carr-Lowrey Glass Company; R. T. Settles, Chattanooga Glass Compang; R. H. Yohler, Fairmont Glass Works, Inc.; R. R. Board, Foster-Forbes Glass Company; James S. Stelle, Gayner Glass Works; John W. Carnahan, Hazel-Atlas Glass Company; G. B. Underwood, Knox Glass Associates, Inc.; A. Langley Coffey, Liberty Glass Company; L. C. Roche, Maryland Glass Corporation; Garrett Bryce, Maywood Glass Company; M. J. Jones, Obear-Nester Glass Company; A. J. Martin, Owens-Illinois Glass Company; John J. Jeffries, Swindell Brothers, Inc.; F. K. Rodewald, Thatcher Glass Manufacturing Company; Ralph Dixon, Tygart Valley Glass Company; and Neal Slack, T. C. Wheaton Company. Ralph A. Lind represented the following companies by proxy: Buck Glass Company, Diamond Glass Company, Glass Containers, Inc., Glenshaw Glass Company, Inc., Lamb Glass Company, Latchford-Marble Glass Company, Laurens Glass Works, Inc., Metro Glass Bottle Company, Northwestern Glass Company, Pierce Glass Company, Reed Glass Company, Inc., and Universal Glass Products Company. The G.B.B.A. was represented by Lee W. Minton, its President, the national officers of the Union and a number of conferees from the many locals throughout the industry.

• At the regular monthly meeting of the Board of Directors of Thatcher Glass Manufacturing Company, a dividend of $.60 per share was declared.

BUCK GLASS ELECTS VICE PRESIDENT

The election of William A. Seger as Vice President and a member of the Board of Directors has been announced by the Buck Glass Company.

Born in New York City in 1901, Mr. Seger graduated from the Ardsley High School in 1918 and attended Columbia University in the Class of 1924. Mr. Seger was connected with the New Jersey Manufacturers Association from 1924 to 1928 and was in the sales department of the Consolidated Feldspar Corporation from 1928 to 1937.

In 1937 he joined the Buck Glass Company and has since been promoted to Sales Manager and now Vice President and member of the Board. Other members of the Board of Directors of Buck Glass Company are Laurence M. Buck, Chairman; Royden Blunt, President; Arthur F. Barstow, Secretary; Bernard J. Ridder; and Walter H. Buck.

OWENS-ILLINOIS REPORT ON EARNINGS

Owens-Illinois Glass Company and subsidiaries earned a net profit of $13,004,554 in the twelve months ended June 30, as compared with $7,667,632 in the preceding 12-month period, W. E. Levis, Chairman, reported at a recent Director's meeting.

The earnings were equivalent to $4.25 a share on the 3,056,874 common shares outstanding June 30, as compared with $2.51 a share on 3,056,859 shares outstanding June 30, 1948.

Directors declared a regular quarterly dividend of 75 cents a common share, payable Aug. 15 to shareholders of record July 30.

LYNCH OFFICERS PROMOTED

The Board of Directors of the Lynch Corporation has announced the creation of the office of Chairman of the Board. Elected to fill this position is T. C. Werbe who has been President of the corporation since its incorporation in 1928.

M. H. Pendergast, who has held the office of Executive Vice President and General Manager for several years, was elected to succeed Mr. Werbe as President. J. P. McCarthy, who has been Director of Manufacturing of the Ohio Division for the past eleven years, was elected a Vice President in charge of Manufacturing in all of the company's plants.

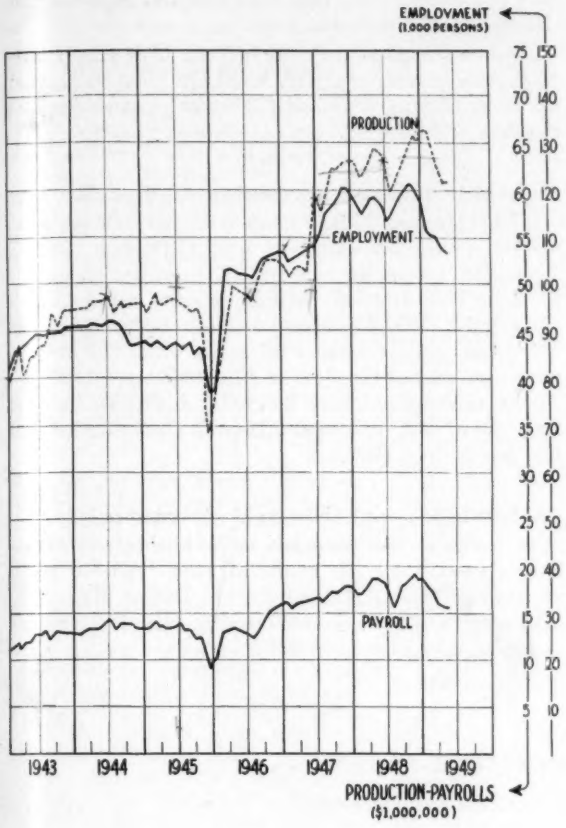
A. P. GREEN FIRE BRICK NAMES EXECUTIVE VICE PRESIDENT

The election of William S. Lowe to fill the position of Executive Vice President has been announced by R. S. Green, President of the A. P. Green Fire Brick Company.

Mr. Lowe comes to the firm from the Reeves-Ely Laboratories, Inc. with which he has been associated since 1944. His career includes a number of years with General Electric Company and SKF Industries. His manufacturing experience has largely been in the field of electrical equipment.

CURRENT STATISTICAL POSITION OF GLASS

THE GLASS INDUSTRY'S INDEX



Estimated production in the glass industry during the month of May 1949 according to the Production Index rose not quite 1 per cent to reach $62,000,000. Production during the month of April 1949 was an estimated $61,350,000. During May 1948, production had been reported to be an estimated $64,000,000, which is about 3 per cent above May this year. Thus far in 1949, production in the glass industry has reached an estimated total of $319,350,000, as compared with $317,000,000 at the close of the corresponding period in 1948—an increase of close to 1 per cent above last year.

Employment and payrolls: During May 1949, employment in the glass industry was 107,600, only slightly below the 107,900 persons employed during the previous month. During May 1948, employment was 117,500, which is a difference of 8 per cent.

Payrolls for the month of May 1949 remained about the same and were reported to be an approximate $16,500,000, the same as for April. During May 1948, payrolls were an estimated $18,000,000, which is about 8 per cent more than for May this year. Total estimated payrolls at the close of the January-May 1949 period have reached $86,350,000. This is about 4 per cent less than the $90,000,000 estimated for the corresponding period in 1948.

Glass container production, based on figures released by the Bureau of Census, for the month of June 1949 continued upward to reach a total of 8,060,774 gross. This is 6 per cent above the previous month's 7,601,647 gross. During June 1948, production was 8,145,009 gross, or slightly higher than for June this year. Total glass container production at the close of the first six months of 1949 has reached 43,813,178 gross. This is 12½ per cent below the previous year's six-month total of 50,190,995 gross.

June 1949 shipments were also an increase over May

GLASS CONTAINER SHIPMENTS
(All figures in Gross)

	June 1949
Narrow Neck Containers	
Foods	717,940
Medicinal & Health Supplies	856,281
Chemicals, Household & Industrial	478,085
Beverages, Returnable	1,018,779
Beverages, Non-returnable	6,625
Beer, Returnable	290,829
Beer, Non-returnable	355,325
Liquors	598,670
Wines	242,208
Toiletries & Cosmetics	409,894
Sub-total (Narrow)	5,129,254
Wide Mouth Containers	
Foods	1,974,530
Dairy Products	241,760
Home Canning	254,842
Medicinal & Health Supplies	215,449
Chemicals, Household & Industrial	80,425
Toiletries & Cosmetics	106,380
Packers' Tumblers	109,050
Sub-total (Wide)	2,931,520
Total Domestic	7,957,072
Export Shipments	208,835
Total Shipments	8,165,907

GLASS CONTAINER PRODUCTION AND INVENTORY
(All figures in Gross)

		Production June 1949	Stocks June 1949
Foods; Medicinal & Health Supplies; Chemicals, Household & Industrial; Toiletries and Cosmetics	Narrow Neck	2,527,641	3,288,017
	Wide Mouth	2,409,474	2,493,625
Dairy Products		251,790	263,084
Home Canning		*160,937	683,162
Beverages, Returnable		1,007,063	658,278
Beverages, Non-returnable		7,436	7,786
Beer, Returnable		278,265	651,841
Beer, Non-returnable		395,158	323,344
Liquors		667,605	487,267
Wines		246,086	274,387
Packers' Tumblers		109,319	138,208
Total		8,060,774	9,268,999

* This figure represents Fruit Jars only.

Specify!

ISCO

Potassium Carbonate, Hydrated 83-85%

ISCO DIAMOND ◊ BRAND

Potassium Carbonate, Calcined 99/100%

(BAGS & BARRELS)

Manufactured by
our ISCO Chemical Division
at Niagara Falls, N. Y.

Sodium Silicofluoride
Beeswax
Ammonium Carbonate
Iron Chloride

INNIS, SPEIDEN & CO.
117 LIBERTY STREET
NEW YORK 6, N. Y.
BOSTON · CINCINNATI · GLOVERSVILLE
CHICAGO · CLEVELAND · PHILADELPHIA
SUBSIDIARY
E. S. BROWNING CO., INC.
SAN FRANCISCO · LOS ANGELES

and were reported to be 8,165,907 gross. This is an increase of close to 4 per cent over May's 7,861,591 gross. During June 1948, glass container shipments were 7,686,682 gross, or 6 per cent less than for June this year. Total shipments at the half-way mark in 1949 have reached 42,800,316 gross. This figure is slightly more than 12 per cent lower than the 48,838,697 gross shipped during the same period in 1948.

Stocks on hand at the close of June 1949 were 9,268,999 gross, as compared with 9,458,172 gross on hand at the close of May 1949 and 8,809,830 gross on hand at the close of June 1948.

Automatic tumbler production for June 1949 was 4,457,171 dozens. This is close to 15 per cent less than for May production which was 5,242,474 dozens. During June 1948, production was 4,357,283 dozens. Shipments for June 1949 dropped about 1 per cent from the previous month's 5,054,771 dozens to reach 4,986,362 dozens. Shipments during June 1948 were 4,742,233 dozens. Stocks on hand at the close of June 1949 were 5,822,703 dozens as compared with 8,614,609 dozens on hand at the close of May 1949 and 8,154,597 dozens on hand at the close of June 1948.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware for the month of June 1949 fell off 3 per cent to reach 3,367,659 dozens. During May 1949, sales were 3,672,072 dozens. During June 1948, manufacturers' sales were 3,846,623 dozens.

RESEARCH DIGEST . . .

(*Continued from page* 451)

ards of known refractive index.

The important features of the apparatus are that the optical system remains fixed and that measurement is always a comparative one, so that the possibility of error is extremely small. The time for the preparation of the sample and the time required for the measurement are small and are much less than the time required for density measurement involving a number of accurate weighings on the chemical balance.

The authors state that while the resources of the laboratory and the services of a skilled technician are needed for density measurements, refractive index measurements can be performed by anyone once the necessary apparatus is installed. They suggest that in those laboratories where the density measurement is already in use, consideration be given to the refractive index measurement since the provision of a second statistical criterion is an advantage in tracing composition variations.

• Frank Ross, National Manager of Lubrication for E. F. Houghton & Company, has been appointed to the newly created post of Assistant to the Vice President-Sales, according to a recent announcement.

NEW EQUIPMENT AND SUPPLIES

NEW MASONRY SAW

Victor Engineering Corporation, Bristol, Pa., has announced the development of a new masonry saw which it states is light, portable and inexpensive yet strong enough to stand up under rough handling.

The rigid tube construction and ¼" angle combine to offer a light machine weighing only 225 lbs. The 1½ H.P. motor drives both water pump and blade to make an efficient dry and wet cutting device. The saw is available in dry-cut models also.

The new Valor masonry saw features a built-in foot pedal arrangement allowing a much greater head-throw than is found in ordinary saws.

HEAVY DUTY BELT SANDER

Henry G. Lange Machine Works, Inc., 166 N. May Street, Chicago 7, Illinois, has announced the development of a heavy duty dry abrasive belt sander which, the company states, will increase production and reduce operating and belt costs while it efficiently and safely filters the air of all glass dust and particles.

Dry grinding is employed. The use of belts dry has been found to cut belt costs as much as half, eliminate washing, water spots and possible damage to silver on mirrors being edged. A V-belt drive affords quick and easy changes of speed at low cost to take advantage of new developments in abrasive belts and grinding techniques which require changes of speed. A glass truck of a new design incorporates the 3-wheel principle. 132" x 4" abrasive belts are used; sander motor is 1 h.p.; dust collector is 1½ h.p. The glass table is 32" wide by 60" long with extensions opening to 56" wide.

FORCED DRAFT "ISOTEM" OVEN

Fisher Scientific Company, 717 Forbes Street, Pittsburgh 19, Pa., has announced its new forced draft "Isotemp" oven for general laboratory use. The oven is said to perform drying operations in one-half to one-third the time required with a conventional gravity-type oven.

The new oven has a motor-fan unit beneath the heating chamber and an arrangement of ducts and louvres which conduct hot, dry air to the heating chamber where the air moves against and completely around the sample. Once the selected operating temperatures (range 75 to 175°C.) is attained, the oven will maintain that temperature within plus or minus 1 degree.

Extra heavy glass wool insulation, aluminum shelving and heavy cast housing afford stability, even heat distribution and efficient operation, according to the manufacturer. Current consumption is 550 watts and oven draws current during only about one-fifth of the time after reaching pre-set temperature.

NEW CYCLOTHERM BOILER

Cyclotherm Corporation, Dept. 75R, 90 Broad Street, New York 4, New York, has announced a new type of high atomizing burner nozzle incorporating a primary air supply assuring precise injection of fuel and air for efficient combustion at all firing rates.

In addition, according to the company's announcement, the new nozzle design permits interchangeable oil or gas firing without requiring a change of nozzle. The nozzle design, combined with the cyclonic combustion principle, maintains high combustion efficiency with either fuel.

The new models of steam generators, incorporating the new type nozzle, also include a simplified air supply system, improved combustion and ignition programming controls and a blower-air channel design that achieves quiet operation.

NEW PHOTOELECTRIC COLORIMETER

E. Leitz, Inc., 304 Hudson Street, New York 13, New York, has announced the manufacture of a new Rouy photrometer giving a concentration reading accurate to within 0.1 per cent. This is made possible by careful matching of the photoelectric cell and the direct reading microammeter. With the photrometer the measured electrical energy is strictly linear to the transmitted light energy.

The photrometer's ten narrow band (40 millimicrons) glass filters give finer definition over the entire visible spectrum. Each filter and filter element is controlled in production and matched to produce identical spectral transmission curves. Further accuracy is insured by the use of a precision square absorption cell which eliminates errors possible with ordinary curved cells, the manufacturer states. The instrument offers maximum reproducibility for different workers can obtain identical readings on the same specimen even on different photrometers.

NEW FLOW INDICATOR

Fischer & Porter Company, Hatboro, Pa., has announced a new rate of flow indicator that is equally useful for clear and opaque streams. The new Magna-Sight flow guide uses the company's standard Bull's Eye body with a fixed diameter orifice at its vertical inlet. A tapered plug is suspended in the fluid stream within the orifice. There is a permanent magnet imbedded in the tapered plug which causes an external steel ball to move against a calibrated flow scale when increasing flow rate causes the plug to rise. The rear enclosure is a heavy Herculite glass window which permits visual observation of the fluid.

Made in eight sizes from ¾" to 4" (screwed or flanged) Standard Magna-Sight flow guides measure maximum flow rates of 3.5 to 250 gpm. Minimum measurable flow rate for any given indicator is 1/10 maximum.

CATALOGUES RECEIVED

St. Joseph Lead Co. of Pa., Josephtown, Monaca, Pa., has issued a brief treatise on the pigment which would provide information on zinc oxide's properties and applications.

The booklet, prepared by the company's technical staff, includes such chapters as Physical and Chemical Properties, Zinc Oxide in Rubber Compounds, Zinc Oxide in Protective Coatings, Zince Oxide in Ceramics (Glass, Enamels, Frit, Clay Products, General), Zinc Oxide—Other Industrial Uses. Also included are several pages of photo micrographs and electron micrographs.

Clipper Manufacturing Company, 2800 Warwick, Kansas City 8, Missouri, is distributing a colorful four-page folder featuring the new Clipper 49er masonry saws.

One of the new models is illustrated on the cover, while inside the folder various applications of other models are shown. Advantages of the Clipper saws are listed and several blades are shown with their particular applications.

Hauck Manufacturing Company, 124-136 Tenth Street, Brooklyn 15, New York, has made available its new 8-page Catalog 409 featuring its Series B low pressure air atomizing oil burners.

The burner is illustrated and its advantages listed, together with a description of its operation. Close-ups of the individual parts of the burner are shown with its specific performance. Line drawings and tables giving capacities and dimensions are given and burner accessories are shown.

Hardinge Company, Inc., 240 Arch Street, York, Pa., has published a sixteen-page discussion of Hardinge wet grinding mills.

Designated Bulletin AH-389, it covers conical ball and pebble mills with installation operating data and flow diagrams, convex-head cylindrical mills, convex-head rod mills, "packaged" wet grinding systems, classifiers, thickeners, feeders, Ruggles-Coles rotary dryers and the Hardinge "Electric Ear."

WYANDOTTE CHEMICALS ELECTIONS

E. M. Ford's election to Chairman of the Board of Directors of Wyandotte Chemicals Corporation has been announced by the Board. Mr. Ford will continue in his present capacity as President until September 1 when he will assume his new post.

Elected to succeed Mr. Ford as President and Director of the corporation is Robert B. Semple, Director of Monsanto Chemical Company's General Development Department.

Mr. Ford has held the presidency of Wyandotte for 6½ years. This period included the important war and immediate post-war years when the firm completed its major expansion program marking their entry into the organic chemicals field.

Holder of a Master's Degree in Chemical Engineering from the Massachusetts Institute of Technology, Mr. Semples joins Wyandotte Chemicals Corporation from Monsanto Chemical Company where he had many years of research and sales experience preceding his appointment as Director of the General Development Department.

DUNBAR APPOINTS DESIGN CONSULTANT

J. O. Reinecke & Associates has been retained as product styling consultant for Dunbar Glass Corporation, Henry E. Payne, President of the glass company has announced.

Mr. Payne further stated that the Reinecke organization will cooperate in the development of designs for Dunbar's custom molded industrial glass products, lighting glassware, and table and novelty glassware.

L-O-F REPORTS RECORD SALES FOR FIRST HALF OF 1949

With record sales in the first half of 1949, Libbey-Owens-Ford Glass Company reported net earnings of $9,105,831, equivalent to $3.56 a share for the six months ended June 30, as campared with $7,103,850, equivalent to $2.78 a share in the corresponding period last year.

The report of John D. Biggers, President of the firm, indicated that second quarter sales surpassed in dollar and unit volume any previous quarter and reflected a steady upward trend over the last four quarters. Business so far in 1949 has been highlighted by substantial gains in automotive glass demand and greatly increased sales of Thermopane.

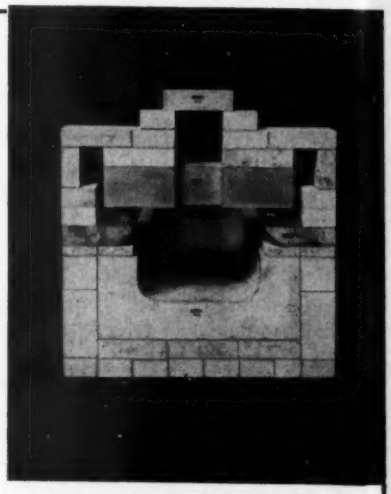
Mr. Biggers reported the outlook for both automotive and building demand as good, provided the general industrial tempo is not interrupted by labor difficulties in basic industries. Directors declared a dividend of 75 cents a share payable September 10 to holders of record August 25.

NEW, MODERN FACILITIES FOR VITRO

The Vitro Manufacturing Company has announced completion of the remodeling of its headquarters and general offices at Corliss Station, Pittsburgh, Pa.

According to the company's announcement, this represents another completed step in its overall expansion and modernization program. Within the past two years, Vitro has increased its manufacturing and production facilities more than 30 per cent and has installed a new research laboratory and reference sample system.

Cleaner Glass, Low Maintenance with **CRYSTALITE Forehearths**



REMMEY CRYSTALITE (mullite-bonded mullite) is produced in all shapes necessary to make up the forehearth assembly. Burner blocks, cover blocks, channels, spouts, tubes, plungers and orifice rings are built to meet specified requirements. These CRYSTALITE parts mean better, more efficient production by offering:

- ★ Accuracy in formation to eliminate time-wasting adjustments.
- ★ High refractoriness and erosion resistance for longer life, fewer replacement shutdowns and cleaner glass.
- ★ Rigid control through each production phase for uniform quality and dimension accuracy.

Get Premium Performance Without Premium Price . . . by using REMMEY CRYSTALITE parts for your forehearth.

Dependable Refractories

REMMEY

RICHARD C. REMMEY SON CO.
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NOW—from Vitro . . .

OFFERING

- √ ***Lower maturity—1000° F.***
- √ ***Longer firing range—approximately 200° F.***
- √ ***Greater stability***

than any colors ever developed for screen application on glass containers!

The completely new and amazing "Duro-Glo" Glass Colors provide the answer to your requirements for superior ware with the ultimate in eye appeal and a minimum of rejects.

Exhaustive tests under actual production conditions have proved "Duro-Glo" the finest colors ever developed for squeegee application on commercial glasses. Because of their unusually long maturing range of approximately 200° F., these newly-developed glass colors are not affected by normal lehr temperature fluctuations. They may be safely applied and fired at both the low and high temperature limits without blistering of color, deformation of glass or chain marks. The result is an extremely stable color with a high gloss and opacity never before provided by colors of this type.

For complete details on the new, sensational "Duro-Glo" Glass Colors, contact a Vitro representative today, or write direct!

YOU CAN ALWAYS RELY ON

PUT VITRO'S NEW, EXPANDED FACILITIES TO WORK FOR YOU!

The combination of techniques and background gained in over 41 years' experience in color manufacture plus the most modern laboratory and research facilities, new production equipment and a new, unique reference sample system are offered to the trade with complete confidence. Our representatives and technicians are always at your service.

FOR POTTERY, GLASS, PORCELAIN ENAMELS

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GAMES SLAYTER HONORED AT PURDUE UNIVERSITY

Games Slayter, Vice President and Research Director of Owens-Corning Fiberglas Corporation, received the honorary doctor of engineering degree from Purdue University at his alma mater's 91st commencement exercises. Shown above, President Frederick L. Hovde (right) congratulates Mr. Slayter as Professor R. Norris Shreve, head of Purdue's School of Chemical and Metallurgical Engineering, adjusts the orange-lined hood symbolizing degree.

Mr. Slayter, who directs the Fiberglas Research Laboratories in Newark, Ohio, was a 1921 Purdue graduate. He was cited for the doctor's degree by Professor Shreve as "a creative scientist and distinguished research engineer from whose talents and vision have come new enterprises advancing our industrial economy". Mr. Slayter has been Vice President and Research Director of Owens-Corning since that company was founded in 1938, and during the seven years prior to that time he originated and directed the development programs that resulted in production of Fiberglas products on a commercial basis.

A. O. SMITH TO PRODUCE GLASS-LINED SILOS

The A. O. Smith Corporation has announced that it will start to manufacture glass-lined, air-tight silos for use in farm feed storage. Mass production of the units is planned for next year.

The silos, with a capacity of 140 tons, are 40 feet high and 14 feet in diameter. Coming in nine steel sections, which are riveted together, the units have layers of glass on both the inside and outside. Officials of the company declare that the air-tight feature of the silo has cut spoilage and in tests has kept contents in good condition for as long as eight months.

CAMBRIDGE WIRE CLOTH APPOINTS CANADIAN AGENTS

The Cambridge Wire Cloth Company has appointed two agents to distribute its line of woven wire conveyor belts to Canadian manufacturers.

The R. D. Travers Company, 25 Houston Street, South, Hamilton, Ontario, will cover the city of Hamilton and the Niagara Peninsula. The Process Equipment Company, 1440 St. Catherine Street, W., Montreal, Quebec, will represent Cambridge in the entire province of Quebec.

Wherever you go...Whatever you see... Banner Lime *is in the picture!*

Banner Lime has been an important material in Miami's picture for many years:

IN BUILDING: Many of the fine skyscraper hotels, apartments and homes along Miami Beach and throughout the Miami area have Banner Finishing Lime in not only interior wall finishes but in exteriors as well. Architects and artisans recognize the advantages in application and durability which Banner Lime gives to natural white or colored finishes — whether smooth-surfaced, sanded or textured.

IN INDUSTRY: Florida concrete building unit manufacturers use Banner Lime for intensifying the whiteness of their products or for the later painting of them. Also Banner Lime is used in making interior cassein paints and for exterior cold water paints for both stucco and roofing tiles. It colors readily and uniformly in producing vivid or pastel shades.

Photo by Fairchild Aerial Surveys, Inc., N. Y. C.

MIAMI IN TODAY'S PICTURE: Miami, Florida — known as The Winter Playground, Gateway to Latin-America, Land of Sunshine and Tropical Breezes — is very much in today's picture. Its multitude of modern ocean-front skyscraper hotels, its apartments and homes, with their white tile roofs and vividly hued exteriors make an unusual and colorful panorama against the blue-green Atlantic. Hundreds of thousands are attracted annually to this unique American Tourists' Paradise.

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Clipper MASONRY SAWS

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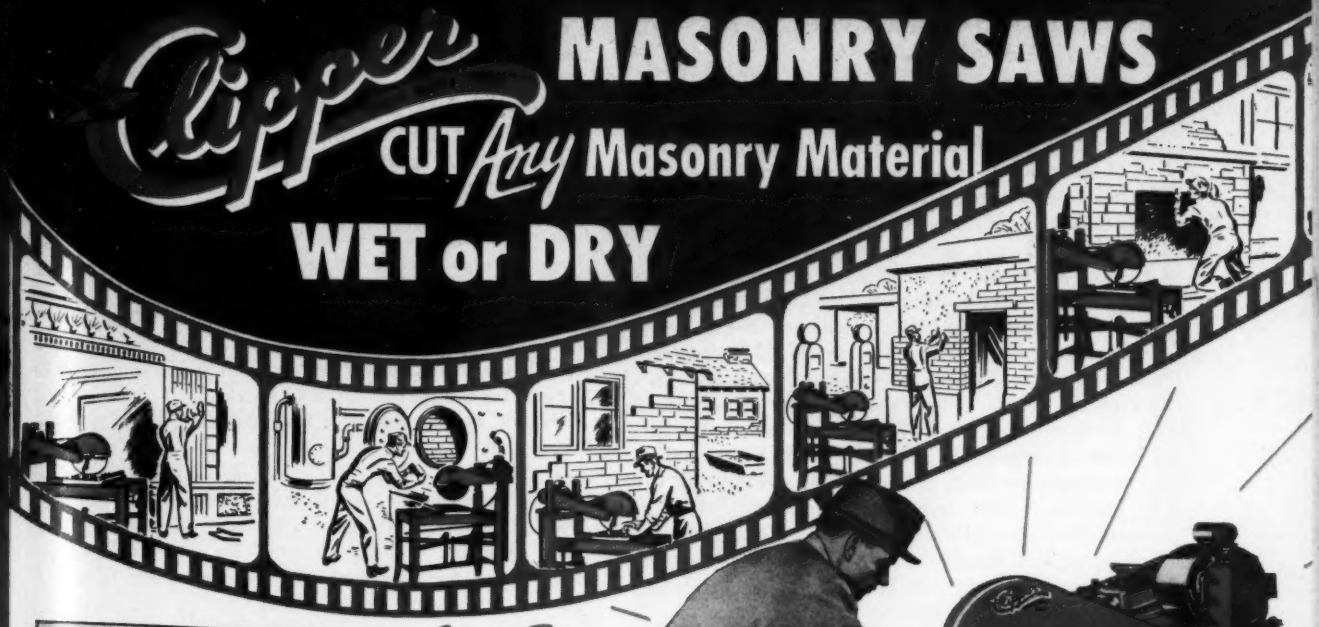

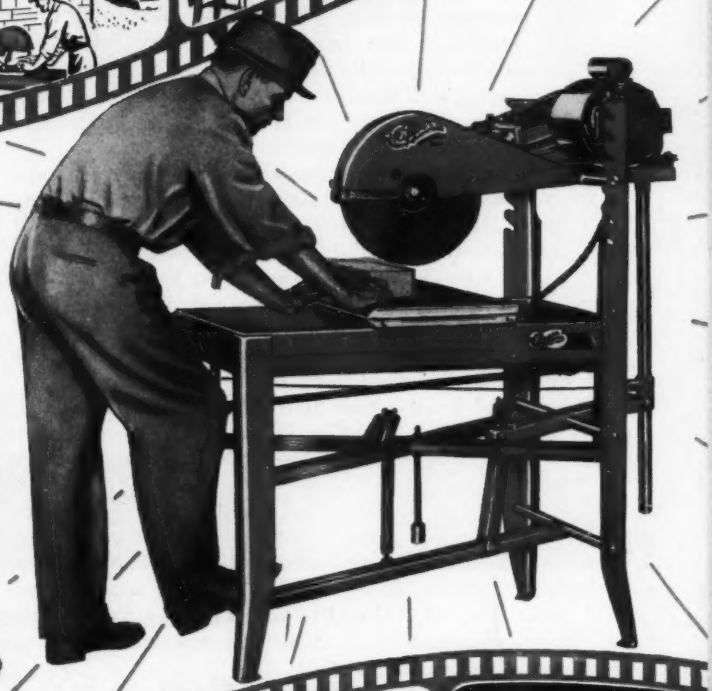

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See—yes, and try any of the Nine Clipper Models on your job, before you buy. Shipped on FREE TRIAL direct from your nearest Clipper Factory Branch . . . Order Today!

Yes Sir YOU CAN CUT THESE MATERIALS *FASTER*--

- NATURAL STONE *cut in* 12 SECONDS
- VITRIFIED PIPE *cut in* 18 SECONDS
- GLAZED TILE *cut in* 21 SECONDS
- GLASS BLOCK *cut in* 8 SECONDS
- FIRE CLAY BRICK *cut in* 4 SECONDS
- ROOFING TILE *cut in* 14 SECONDS
- CONCRETE BLOCK *cut in* 19 SECONDS

ONLY Clipper HAS *THESE* FEATURES

● Only with Clipper do you get that smooth, sensitive cutting performance . . . and why . . . because your Clipper has the "Multiple Cutting Action", "Adjust-A-Cut" Control, Automatic Blade Pressure Equalizer, and the "Fatigue-Free" Conveyor Cart. Add up these features and you have Clipper—the original masonry saw. Every cut, angle or straight—simple or intricate, is made faster, more economical, and easier with any of the NINE CLIPPER MODELS.

When Dust is a problem choose the Model HD for the DUSTLESS (wet) or dry cutting even next to intricate machinery. Tear off the coupon . . . NOW . . . for full details on FREE TRIAL.

FOR DUSTLESS CUTTING it's the HD-49 CLIPPER Cuts Wet or Dry

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STREET _____

CITY _____ ZONE _____

STATE _____

SOLD DIRECT... *from Factory to User*

BONDED REFRACTORIES FOR SPECIAL PURPOSES . . .

(*Continued from page* 440)

for replacing worn out parts. 2) Less refractory is dissolved into the glass, at the spout, minimizing the rejection of ware due to inclusions of refractory which could be traced to the expendable parts. Fig. 10-11-12. 3) Bonded mullite refractories will NOT drip and as they are low in iron, any glass which condenses on the working face, above the metal line, will remain relatively clean. Fig. 4. With ordinary fire clay refractories, the glass which condenses on the exposed face is usually stained a greenish-brown, from iron oxide in the refractory. Fig. 5. These drips melt off and are drawn through the orifice, to form tadpoles in the ware. Fig. 6-7. Iron bearing impurities in clay refractories seem to be attacked selectively by some type of opal or opalescent glasses resulting in transparent streaks with varying degrees of iron color. Low iron bonded mullite refractories—especially feeder parts—are advantageous in reducing such streaks. Fig. 8-9. 4) The composition and firing temperature may be varied to meet individual service conditions. Fig. 13-14.

Up to 90% of the vulnerable joints in breast walls which are built of silica brick can be eliminated by using larger blocks for the Unit Port Jamb and Breast Wall construction. Fig. 15-16-17. These photographs were taken of bonded mullite port jambs, breast walls and tuckstones after 12 months in a container glass tank. These blocks are ground to size and marked for placement, saving time and masons' expense on the job. They can be cut or trimmed on the job, if necessary.

Bonded mullite Unit Port Jamb and Breast Walls, Tuckstones, Port Sills after 765 days of continuous service: 362 days on lead glass and 305 days on flint glass for tubing. Also used in suspended back wall over batch feeder and for front wall. Bonded mullite refractories are those which appear dark grey in the photographs. Bonded mullite suspended end wall in connection with blanket type batch feeder after 832 days in window glass tank. Fig. 21. Complete end wall including mantel arch and mantel block, after 44 months and 20 days in plate glass furnace. Fig. 22.

These photographs, Fig 23, #1 Port, Fig. 24, #3 Port, show why bonded mullite brick, both the standard and fortified grades, are so widely used in both container, tableware and flat glass furnaces. They accomplish 4 very definite results: 1) These brick prolong the life of the ports and eliminate the necessity for making hot repairs to the ports during the campaign. 2) They hold the original port dimensions and shape longer, contributing to the control of the shape and direction of the burning gases. 3) When used to replace fire brick, super-duty, kaolin or high alumina brick there is less clogging of the checkers. The product formed at the hot face of these refractories, in combination with batch carry-over, either as a solid or as vapor, will flow at port temperatures, dropping into the checker chamber. This slag carries sufficient alumina from the fire brick to permit it to freeze solid at regenerator temperatures. 4) Ports built of bonded mullite brick can be insulated safely, reducing heat losses through the ports and making more comfortable working conditions. Insulation does NOT increase the hot face temperature and the high softening point of bonded mullite refractories makes insulation practicable.

Best results are obtained if a minimum of 9″ of bonded mullite brick is used for back ports, tied into either 4½″ of fire brick or suitable insulating fire brick.

Illustrating, Fig. 25-26, how bonded mullite brick are used to veneer the opening in the regenerator crown, below the port uptakes. These brick are all laid in mullite base, non-shrinking cement to prevent joint erosion. They are also used for the top 6 to 9′-0″ of regenerator division walls and for a similar depth at the top of both the front and back walls of the regenerator chamber, beneath the back ports. Here hot load strength and freedom from shrinkage are essential in order to provide support for the port up-takes and necks.

Bonded mullite mantel arch and mantel block in container tank after 22 months. Salvaged and used for 2nd campaign. Fig. 27. Fortified bonded mullite shapes for suspended port arch burner blocks for oil firing in 1st port of a 6 port tank melting container glass. Fig. 28. Bonded mullite brick used to hot patch silica crown and port arch in container tank. Installed without pre-heating, ran 6 months for life of the tank. Fig. 29-30.

Test flux blocks of pneumatically tamped bonded mullite in boro-silicate tank after 12 months. Very little upward drilling evident despite the fact that these blocks projected nearly 7″ beyond the surrounding bonded hi-alumina tank blocks. This company is now melting boro-silicate glass of high quality in continuous tanks in which the melter, bridge wall and refiner are built of bonded mullite tank blocks. Fig 31. Nose of suspended shadow wall 1059 days. Fig. 32. Special shapes of bonded mullite in the eye of regenerative pot furnaces, after 5 years and 3 months of continuous service. The bench was repaired with mullite ramming mix and cement. Fig. 33.

MINIMUM WAGE SET FOR PRESSED AND BLOWN INDUSTRY UNDER PUBLIC CONTRACTS ACT

Effective August 16, the wage for employees engaged in the manufacture or supply of products of the Pressed and Blown Glass and Glassware Industry in amounts of more than $10,000 in value purchased by the Government under the Walsh-Healey Public Contracts Act must be no less than 83½ cents an hour.

This was announced by Secretary of Labor Maurice J. Tobin in adoption of an amendment to the U. S. Department of Labor's 1938 prevailing minimum wage determination for the Flint Glass Industry. In addition to increasing the new minimum wage finding over the 1938 level of 42½ cents an hour, the amendment also established a subminimum rate of 78½ cents an hour for beginners under prescribed conditions.

The revised determination also changes the industry designation from Flint Glass Industry to Pressed and Blown Glass and Glassware Industry.

• Charles W. Owens has been appointed Superintendent of the Birmingham Works of Harbison-Walker Refractories Company. Mr. Owens has been associated with the firm since 1935.

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• Fretting over colors that won't fit your ware isn't a practical way of getting at the source of the trouble. But Drakenfeld, backed by years of broad experience in glass and ceramic color research and production methods, may find the solution to your specific problem.

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Drakenfeld

CLASSIFICATION OF INDUSTRIAL EYE-PROTECTIVE GLASSES . . .

(*Continued from page* 443)

It is, of course, possible to use an instrument of this type with a commercial incandescent lamp, operated on a 60 cycle a.c. line, as a source of modulated light without the use of the motor and disk arrangement. In this case the feedback network of the second amplifier stage is modified to give maximum positive feedback at 120 cycles per second. A network found practical for this purpose is shown at A in the lower part of Figure 1. The relative frequency response when using this network is shown at A in Figure 2. The lower curves, B and D, indicate the relative gain in stage 2 with the network disconnected. If the tuned L-C circuit shown at B in Figure 1 is employed, the shunting capacitance is simply increased until maximum gain is reached.

Since this particular amplifier is not especially designed for 120 cycles per second and since the 100-watt incandescent lamp is only partially (about 10 per cent) modulated as regards light output at 120 cycles, the overall efficiency is greatly reduced so that measurements are difficult for industrial welding glasses in shades darker than numbers 11 or 12. Little could be gained by going to more powerful lamps since they have heavier filaments and hence lower per cent modulation at 120 cycles. Certain changes could be made within the amplifier circuit to adapt it more suitably to 120 cycles if desired, but it is felt that at least for the darker shades, above 10, the use of one of the 510 cycles per second circuits is more suitable for accurate work because they are relatively free from 60 and 120 cycle line and power supply interference.

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SEVEN GLASS COMPANIES AWARDED FOR 1948 ANNUAL REPORTS

From the 4,200 corporation annual reports for 1948 submitted in the Ninth Annual Survey conducted by Weston Smith of *Financial World*, seven glass manufacturing companies have qualified for "Highest Merit Award" citations: American Optical Company, Anchor Hocking Glass Corporation, Bausch & Lomb Optical Company, Corning Glass Works, Libbey-Owens-Ford Glass Company, Pittsburgh Plate Glass Company and Univis Lens Company.

The stockholder reports of these companies have thus become candidates for the final judging and one will be selected for a "Best of Industry" award and presented with a bronze "Oscar of Industry" at the *Financial World* Annual Report Awards Banquet on October 31, 1949. A year ago, the 1947 Annual Report of American Optical Company won the trophy in this industrial classification.

MELTING and FINING

BORAX...a small addition of B_2O_3 to the glass batch, if properly substituted for a part of one or more of the major constituents, will improve the melting temperature and fining rate which should effect economies in fuel and refractory life.

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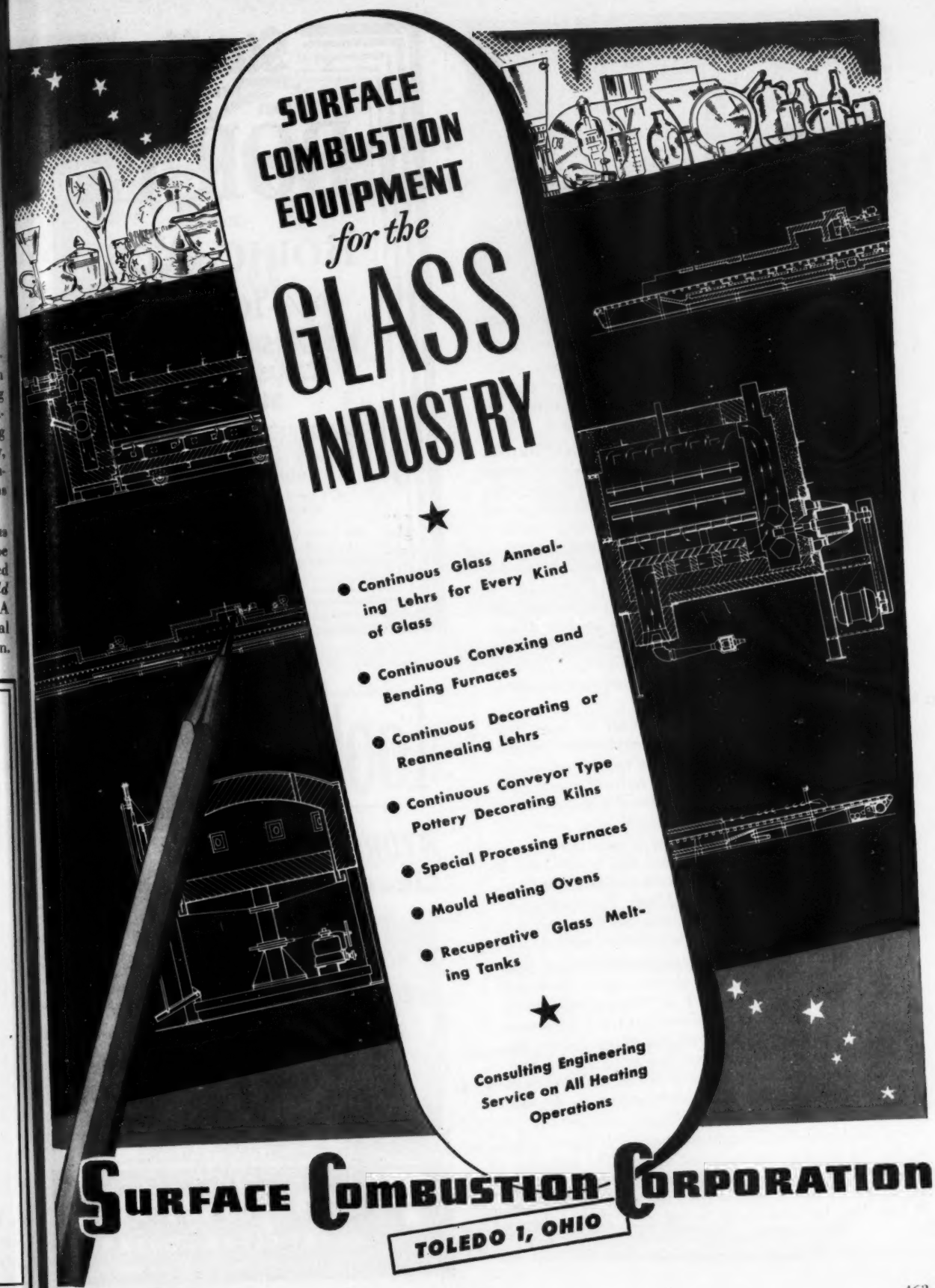
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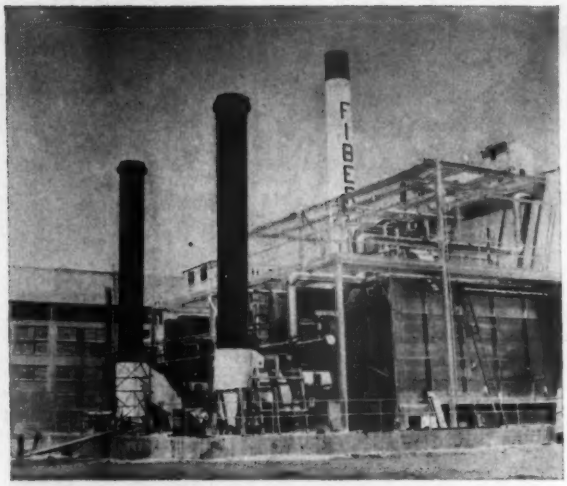

OWENS-CORNING STARTS OPERATIONS AT SANTA CLARA PLANT

Operations at the $7,000,000 Owens-Corning Fiberglas Corporation plant at Santa Clara, California, have gotten underway. The plant has been under construction since early 1948 and with an initial group of 275 factory and office employees, is now turning out Fiberglas building and industrial insulation materials. Within a short time, it is expected that cold storage and aircraft insulation will be produced.

The new plant consists of the main factory, administration building, warehouse, boiler house, asphalt house, batch materials storage building, binder mix building, fire protection building and well pump house. The nine buildings place under roof a total area of 346,000 square feet, nearly eight acres.

The plant production line starts with the batch materials storage building into which are unloaded the raw materials—sand, limestone and other minerals—brought to the plant in freight cars. Two railroad spurs serve this storage building and six additional spurs serve the warehouse and shipping docks.

From the storage building, the batch materials are carried by belt conveyors to a 56-cubic foot mixer. Batch buckets carry the mixed batch via a tramrail system to the furnace where the batch is melted. The plant starts operations with one furnace, but space has been provided for installation of a second furnace when needed.

The molten glass flows from the furnace through perforated bushings and the thin streams issuing from the bushings are struck by a blast of high-pressure steam which stretches them into fine fibers that fall upon a conveyor. A binder is sprayed on the fibers and as the blanket-like mass of fibers is carried along by the 250-foot conveyor, it is compressed to the desired thickness and density, passed through an oven section to dry the binder and cut to desired size and shape.

A rigid, board-like form of the material is coated with asphalt for low-temperature installations. The asphalt is handled through steam-jacketed lines and pumps into an asphalt heater and is carried from the heater to the production line by electrically heated pipe lines. Other forms of the material may be given a paper facing or may be enclosed in a paper jacket.

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Cleans Glass Molds Faster

Pangborn Hydro-Finish rapidly cleans glass molds and, as the photos show, leaves molds bright and ready to use. Little or no hand polishing is necessary. Sharp edges and contours are maintained. Extremely fine mesh abrasive suspended in water is used as the blasting medium.
Complicated molds are cleaned throughout. Tolerances are held to .0001" —substantially increasing mold life.
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The best abrasive for all liquid blasting needs. Available in many different mesh sizes.
Pangborn
BLAST CLEANS CHEAPER
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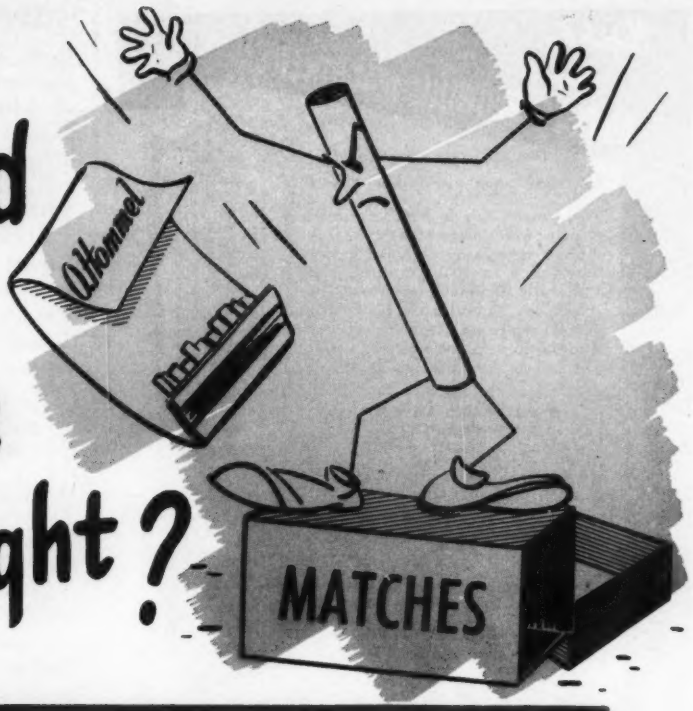
What good is a cigarette without a light?



WHAT GOOD IS YOUR SUPPLY OF COLORS WHEN THEY DON'T MATCH!

When you're not properly stocked with the right combination of materials—they become useless . . . almost a complete loss! A cigarette without a light . . . or a supply of colors that don't match—hardly useful.

Guard against this impractical situation—don't let a stock of colors accumulate in your inventory. Whether you're using over glaze, under glaze, glaze stains, enameling oxides or any other ceramic color . . . rely on Hommel's Complete Color Matching Service to give you uniform product from shipment to shipment.

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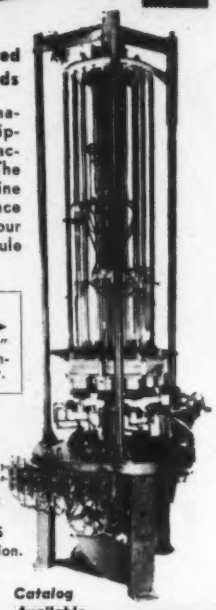

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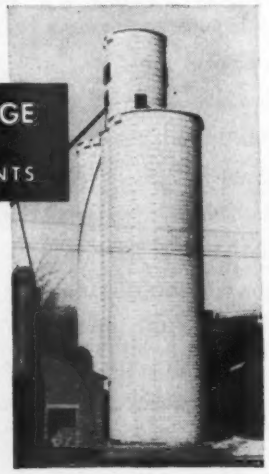


During the last 32 years, Neff & Fry Storage Bins have withstood practically everything Nature offers . . . heat, cold, moisture, corrosion . . . even fire and storm. This is due to the stonelike properties of N & F Super-Concrete Staves, plus the erection technique.

The staves have matching grooved and beaded edges. Each stave interlocks with six adjacent ones. For contents which must be kept dry, dampproofing is accomplished by buttering the edges of the staves with mastic compound, coating the inside and outside of the bin with neat cement, and then adding two coats of waterproofing compound to the outside. To withstand internal pressure, the structure is bound with galvanized steel rings, as illustrated in the accompanying photograph.

Neff & Fry Bins Built For Little Elevator Co., Rockford, Ohio

If you are interested in storage bins which last for generations, get all the facts about Neff & Fry Super-Concrete Stave Bins. Complete information is yours for the asking. Write, wire, or phone.

THE NEFF & FRY COMPANY, CAMDEN, OHIO

NEFF & FRY STORAGE BINS

APPOINTMENTS AT GLASS FIBERS, INC.

R. H. Barnard, President of Glass Fibers, Inc., has announced the appointment of F. J. Solon, Jr., as Director of Advertising and Public Relations. Prior to joining Glass Fibers, Inc., Mr. Solon was with the advertising drug division of American Home Products Corporation and was allied with the radio industry in Toledo until 1941.

At the same time, Mr. Barnard announced that R. W. Capaul had been appointed General Sales Manager of the firm. He had been Manager of the Electrical Division. Mr. Capaul was formerly in the Power Sales Division of Toledo Edison Company for twelve years, and is an engineering graduate of the University of Toledo.

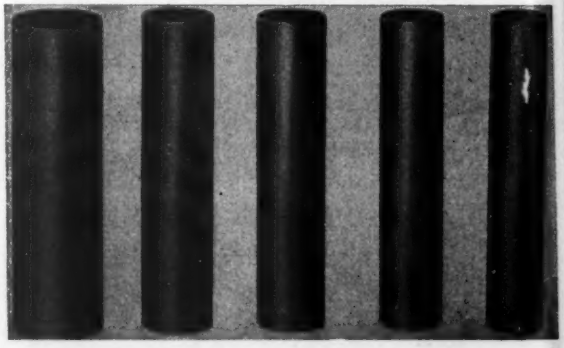
BULLETIN ON SHEET GLASS ECONOMICS OFFERED BY WASHINGTON COLLEGE

A bulletin entitled "The Economics of Sheet Glass Production in the Pacific Northwest" has been published by the Bureau of Economic and Business Research at the State College of Washington.

The booklet is a result of a study which was made in an attempt to analyze the economic feasibility of producing and marketing sheet glass in the Northwest. The booklet includes such chapters as Sheet Glass Industry in the United States (Manufacturing Processes and Locational Factors), Marketing and Price Policies, Possibility of Producing Sheet Glass in the Pacific Northwest and Markets for a Northwest Sheet Glass Plant.

The bulletin is available, free of charge, through the State College of Washington, Pullman, Washington.

GUNITE



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PRODUCTION FACILITIES EXPANDED AT CAMBRIDGE WIRE CLOTH

The Cambridge Wire Cloth Company has erected an additional bay at its home plant in Cambridge, Maryland. The 18,000 square foot additional was built especially to house the company's wire fabrication department.

New and modern machinery has been installed to provide more extensive facilities for this department. Included are squaring shears, bending brakes, ring and circle shears, calendaring rolls and roll forming equipment. In addition, the firm now has complete equipment for all types of welding, including electric arc, oxy-acetylene, heliarc and spot welding.

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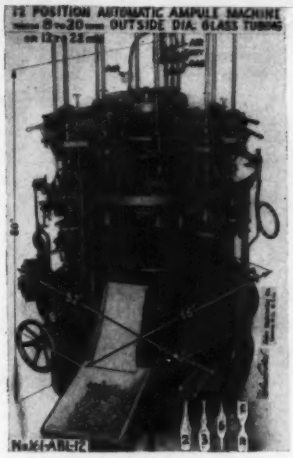

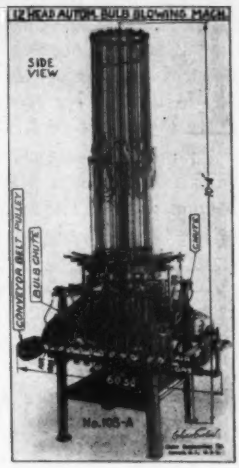

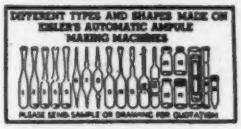
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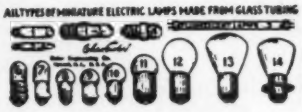

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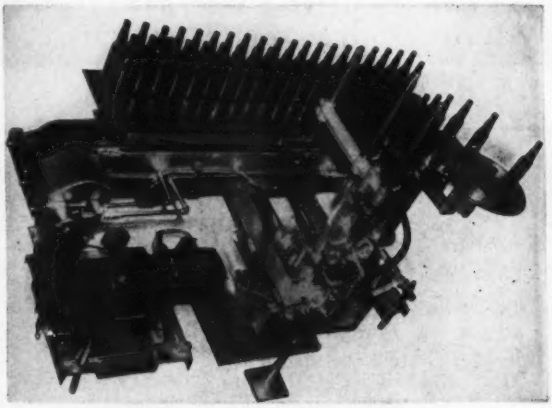

GLAPAT CORPORATION
Zanesville, Ohio

BUREAU OF STANDARDS DEVELOPS NEW SAMPLING PLAN

A modified sampling plan for use in large-quantity buying requiring inspection to determine whether or not the material meets the specified standard of quality has been developed by J. M. Cameron and W. J. Youden in the Statistical Engineering Laboratory of the National Bureau of Standards. The new plan makes possible a saving in the average amount of inspection that may range from 20-40 per cent, according to the Bureau's report.

In the new scheme, the regular testing procedure is interrupted after a predetermined number of units have been examined. The material is accepted if the test results at the time of interruption fulfill the criteria of a simple rule that requires neither computation nor the use of tables. If the material does not pass the test, the inspection is completed in the usual manner. In either case, the inspection procedure itself remains unchanged.

The new plan calls for a number of units being drawn (the same number as in the single sampling test), but the regular testing procedure is interrupted after a fixed number of items have been tested. If a predetermined number of these test results individually exceed the acceptance of the original plan, the material is immediately accepted and testing stopped. If less than the required number meet the acceptance value, testing is completed in the usual way and the individual test results are averaged. Acceptance or rejection then depends on whether or not this average exceeds the acceptance value.

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